

FLOODING: MANAGING HEALTH RISKS IN THE WHO EUROPEAN REGION



Abstract

Over the last 20 years, flood events have occurred in 49 countries in the WHO European Region. These have caused more than 2000 deaths, other health effects, property losses, damage to health facilities, displacement and enormous economic costs (estimated at €70 billion). A survey of countries in the Region highlighted the gaps in the prevention of health effects of floods and the availability of timely flood–health response strategies or established action plans. Further cross-sectoral coordination is crucial in preventing deaths, injuries, disease and other health consequences. A range of measures to protect population health care are proposed in this publication, organized around prevention, preparedness, response and recovery. Approaches to manage the health risks of floods should be based on the common policies, plans and measures for all types of hazards, before addressing the specific issues associated with floods.

Keywords

Floods

Disaster Planning

Risk Management

Public Health

Europe

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ISBN 9789289052795

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Acknowledgements

This document was developed by WHO Regional Office for Europe staff: Matthias Braubach (Technical Officer); Ana Paula Coutinho Rehse (Technical Officer); James Creswick (Technical Officer); Ute Enderlein (Technical Officer); Dorota Jarosińska (Programme Manager); Vladimir Kendrovski (Technical Officer); Bettina Menne (Programme Manager); Elizabet Paunovic (Head of WHO European Centre for Environment and Health); Miguel Antonio Salazar (intern); Gerardo Sanchez (Technical Officer); Oliver Schmoll (Programme Manager); Enkhsetseg Shinee (Technical Officer); Kai von Harbou (Technical Officer); Irina Zastenskaya (Technical Officer); and, from WHO headquarters, Jonathan Abrahams (Technical Officer).

Thanks are due to the colleagues who contributed comments, namely: Miljana Grbic, Haris Hajrulahovic, Thomas Hoffmann, Aliya Kosbayeva, Antoinette Kaic-Rak, Hilde Kruse, Srđan Matic, Dorit Nitzan, Hanne Pedersen, Dina Pfeiffer, Jukka Pukkila, Christiana Salvi and Juan Tello.

The authors are particularly grateful for the comments received from the representatives of Member States and experts who attended the meeting: Prevention, preparedness and response to reduce or avoid health effects of flood events, 19–20 October 2015, Bonn, Germany. Member states representatives: Arben Luzati (Institute of Public Health, Tirana, Albania); Nune Bakunts (National Center of Disease Control and Prevention, Yerevan, Armenia); Hashim Hashimov (Republican Center of Hygiene and Epidemiology, Baku, Azerbaijan); Niyazi Zamanov (Ministry of Emergency Situations, Baku, Azerbaijan); Oleg Panchuk (Ministry of Health, Minsk, Belarus); Luc Tsachoua (Federal Public Service Health, Food Chain Safety and Environment, Brussels, Belgium); Goran Čerkez (Federal Ministry of Health, Sarajevo, Bosnia and Herzegovina); Dzejna Milakovic-Ramadani (Ministry of Health and Social Welfare, Banja Luka, Bosnia and Herzegovina); Maja Dragosavac (Croatian Institute of Emergency Medicine, Zagreb, Croatia); Maëlle Jean-Baptiste (Ministry of Social Affairs, Health and Women's Rights, Paris, France); Levan Baidoshvili (National Center for Disease Control and Public Health, Tbilisi, Georgia); Gesa Lücking (Bundesministerium für Gesundheit, Bonn, Germany); Stefania Marcheggiani (National Institute of Health (ISS), Rome, Italy); Alтынбу Uraimova (Ministry of Health of the Kyrgyz Republic, Bishkek, Kyrgyzstan); Irina Gudaviciene (Health Emergency Situations Centre of the Ministry of Health, Vilnius, Lithuania); Vladimir Dobricanin (Clinical Centre of Montenegro, Podgorica, Montenegro); Cristina Abreu Santos (Directorate-General of Health, Lisbon, Portugal); Mario Silvestre (National Authority for Civil Protection, Lisbon, Portugal); Ion Salaru (National Centre of Public Health, Chisinau, Republic of Moldova); Viacheslav Chubayko (Ministry of Healthcare, Moscow, Russian Federation); Dragana Dimitrijević (Institute of Public Health of Serbia “Dr Milan Jovanović Batut”, Belgrade, Serbia); Miljan Rancic (Institute of Public Health of Serbia “Dr Milan Jovanović Batut”, Belgrade, Serbia); Milada Estokova (Public Health Authority, Bratislava, Slovakia); Mirjana Dimovska (National Institute of Public Health, Skopje, The former Yugoslav Republic of Macedonia); Dovranmuhammet Saparov (Ministry of Health and Medical Industry, Ashgabat, Turkmenistan); Iryna Rudenko (State Sanitary and Epidemiological Service, Kiev, Ukraine); and Jasur Abdurakhmanov (Republican Center of Hygiene and Epidemiology, Tashkent, Uzbekistan. Temporary advisers: Angie Bone (Public Health England, London, United Kingdom); Angela Braubach (Federal Office of Civil Protection and Disaster

Assistance, Bonn, Germany); Sari Kovats (London School of Hygiene & Tropical Medicine, London, United Kingdom); Franziska Matthies (freelance consultant, Feldafing, Germany); and Virginia Murray (Public Health England, London, United Kingdom). Representatives of other organizations: Franz Karcher (European Commission, Luxembourg); and Zbigniew Kundzewicz (Intergovernmental Panel on Climate Change Secretariat, Poznań, Poland). WHO Regional Office for Europe staff: Dovile Adamonyte (intern); Shinee Enkhtsetseg (Technical Officer); Vladimir Kendrovski (Technical Officer); Bettina Menne (Programme Manager); Elizabet Paunović (Head of WHO European Centre for Environment and Health); Miguel Salazar (intern); Oliver Schmoll (Programme Manager); Kai von Harbou (Technical Officer); and Tanja Wolf (Technical Officer).

The WHO Regional Office for Europe is grateful for the funding received from the German Ministry for the Environment, Nature Conservation, Building and Nuclear Safety which enabled organization of the discussion meetings.

Executive summary

In the WHO European Region, floods are the most common natural hazard leading to emergencies, causing extensive damage, disruption and health effects. Over the last 20 years flood events have been recorded in 49 of the 53 Member States. Estimates for the WHO European Region based on data from the international disaster database (EM-DAT) indicate that approximately 400 floods have caused the deaths of more than 2000 people, affected 8.7 million others and generated at least €72 billion in losses in the period 2000–2014 (Guha-Sapir et al., 2015).

The magnitude of the physical and human costs of such events can be reduced if adequate emergency prevention, preparedness, response and recovery measures are implemented in a sustainable and timely manner. Resilient and proactive health systems that anticipate needs and challenges are more likely to reduce risks and respond effectively during emergencies, thereby saving lives and alleviating human suffering.

Over the last few years, countries in the Region have requested assistance from WHO Regional Office for Europe during severe flood events. Moreover, a survey conducted by WHO and Public Health England highlighted the gaps in the prevention of the health effects of floods and in the availability of coordinated and systematic flood–health response strategies or action plans.

Experiences in the Region indicate a need to shift the emphasis from disaster response to long-term risk management. The approach should include health impact assessments of structural measures to combat flooding; specific building regulations in flood-prone areas and insurance policies. Flood–health risk management – through the development of flood–health action plans – should therefore be considered multisectoral. This encompasses systematic analysis and management of health risks posed by floods, through a combination of hazard and vulnerability reduction measures to prevent risks, as well as response and recovery measures corresponding to the four phases of emergency management: prevention, preparedness, response and recovery. Hospitals, ambulance stations, retirement homes, schools and kindergartens in flood-prone areas are at particular risk: evacuation of patients and other vulnerable groups may represent special challenges.

In this publication, the authors propose the development of a flood–health emergency risk management plan, and describe some of the essential elements. This management plan has to be flexible but specific, so that it can be nationally adjusted as required. Definitions of the terms and potential sources from WHO and other international organizations are provided in Annex 1 and II. A range of information sheets on public health advice for health authorities, health professionals, local authorities and emergency managers are provided in Annex III. The publication builds on an extensive literature review, published by WHO Regional Office for Europe and Public Health England (Menne and Murray, 2013).

Abbreviations

DRR	disaster risk reduction
ERC	emergency risk communication
IHR	International Health Regulations
IPCC	Intergovernmental Panel on Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
WNF	West Nile fever
WNV	West Nile virus
WSP	water safety plan

Introduction

Health effects of flood events arise directly through contact with floodwaters or indirectly from damage to health facilities, infrastructure, ecosystems, food and water supplies or social support systems. They can be immediate or appear days, weeks or months after the floods have receded. Over the last 20 years flood events have been recorded in 49 Member States in the WHO European Region. Since 2000, 400 large-scale flood events registered in the EM-DAT database have caused the deaths of more than 2000 people, affected 8.7 million others and generated at least €72 billion in losses (Guha-Sapir et al., 2015). EM-DAT does not include many smaller-scale flood events that have also occurred on a regular basis in countries of the WHO European Region.

Extreme precipitation events are frequent and projected to increase in the WHO European Region. And even though the frequency of wet days is projected to decrease in summer, the intensity of extreme rain showers may still increase. This could result in more frequent and more intense floods of various types. Moreover, there are several geological and historical records of tsunamis in Europe, mainly in the Mediterranean and Black Sea regions. Tsunamis caused by submarine or terrestrial landslides have occurred mainly in Norway, but also in some other areas in Europe. Hence, it is reasonable to prepare for such events, even though no devastating tsunamis have occurred in Europe in the last 100 years (ESPON, 2005).

Population vulnerability to the health effects of flooding is due to complex interactions between various factors: severity and rapidity of the flooding; housing and workplaces located in high-risk areas and high-risk built environments; health status and necessity of regular treatment; access to, and availability of, flood warning and evacuation; rapidity of response measures (Menne and Murray, 2013); and access to health services. All populations affected by floods are at direct or indirect risk of health impacts during and after the event (Tunstall et al., 2006).

Member States most commonly reported shortages of safe water, poor sanitation, injuries and disruption of health services during flood events. Flooding of health facilities results in interruption of business; lost or damaged infrastructure; higher numbers of patient admissions; and increased difficulty in providing routine medical and nursing care for patients with chronic diseases. Several shortcomings in flood–health prevention, preparedness, response and recovery have been observed, including the following examples.

Health protection measures are often not considered explicitly in multisectoral all hazard emergency response plans and, where they do exist, mainly concern response to acute impacts.

- Health service operational analysis (e.g. hospital safety and functionality) is seldom integrated into multisectoral and multihazard risk assessments.
- Advance planning seldom includes provision of sufficient quality and quantities of water and food, sanitation and hygiene; health precautions during clean-up activities; protective measures against communicable diseases and chemical hazards; surveillance activities for mortality and morbidity during and after flood events; or measures to track and ensure mental health and well-being during floods and after flood events.
- Health benefits or risks associated with long-term structural and non-structural measures are seldom considered.

- Weather warnings for extreme precipitation events exist in almost all European countries. However, specific flood warning is often not timely enough to allow health systems to take proper action (e.g. evacuating people at high risk). Gender-sensitive approaches and approaches towards population groups with particular vulnerabilities (e.g. elderly, chronically sick and migrant people) often are not considered in the planning phases (Menne and Murray, 2013).
- Legal environments in many Member States do not allow for timely supply of aid, especially medications and consumables.

To guide overall disaster risk reduction measures, the United Nations Office for Disaster Risk Reduction (UNISDR) and Member States adopted the Sendai Framework for Disaster Risk Reduction 2015–2030. The priorities in this framework focus on understanding the risk of disaster through research; strengthening governance in managing disaster risk; investing in disaster resilience; and preparing for effective disaster response and recovery following the so-called build back better approach (UNISDR, 2015).

Scope of this document

This document is intended to assist health authorities in preparing for, and responding to, flood events, with the aim to reduce flood–health effects. The authors describe the elements of flood–health emergency risk management derived from the health system building blocks, emergency management principles and core capacities of the International Health Regulations (IHR), reflecting the four main phases of the emergency management cycle: (i) prevention; (ii) preparedness; (iii) response; and (iv) recovery.

A series of information sheets of an operational nature accompany this document. These are targeted at ministries of health; national, regional and local health authorities; health professionals; emergency managers; and local authorities. They can be annexed to national or regional plans or used before, during or after a flood emergency, adapted to local needs.

Overview of health effects of flood events

The health impacts of floods and landslides vary between affected populations (related to their vulnerability, exposure and capacities to reduce risks and cope with the event). They also differ according to the type of flood event (e.g. slow onset or fast onset) and the background health situation of the population and access to health services. Two thirds of deaths associated with flooding occur from drowning; the rest result from physical trauma, heart attacks, electrocution, carbon monoxide poisoning or fire associated with flooding. Often, only immediate traumatic deaths from flooding are recorded. Morbidity associated with floods is usually due to injuries, infections, chemical hazards and mental health effects (both acute and delayed). The longer-term health effects associated with a flood are less easily identified but include effects due to displacement, destruction of homes and delayed recovery as well as health consequences (e.g. vector-borne diseases) arising from poor performance of water supply and sanitation services (Menne and Murray, 2013).

The most common health-relevant occurrences during floods reported are shortages of safe water, poor sanitation, injuries and disruption of access to health services. Though rare, outbreaks of infectious disease can happen after flood events. Known risk factors for flood-related increased mortality and morbidity are: fast-flowing water; hidden hazards; water of unknown depth; driving and walking through floodwater; floodwater contamination (by chemicals, sewage and residual mud); exposure to electrical hazards during recovery and cleaning; unsafe drinking-water; food shortages and contamination; poor hygiene conditions; carbon monoxide poisoning; and lack of access to health services (Menne and Murray, 2013).

Flooding of health facilities results in increased patient admissions and difficulty in providing emergency and routine medical and nursing care for patients with chronic diseases due to interruption of business and loss of infrastructure (Kanter et al., 2015; Menne and Murray, 2013; Van Minh et al., 2014).

Population vulnerability to the health effects of flooding is due to a complex interaction of various factors: severity and rapidity of the flooding; health status and necessity of regular treatment; access and availability of warning; rapidity of response measures; and housing and workplaces located in high-risk areas. In many situations it is not the hazard itself that necessarily leads to an emergency, but rather the population's vulnerability and inability to anticipate, cope with, respond to and recover from its effects (IPCC, 2012; Menne and Murray, 2013).

Measures for prevention, preparedness, response and recovery need to be based on risk assessments that determine which population areas are at risk of flooding, and those subpopulations which are at higher risk, in order to reduce the impact of flood events upon health (Menne and Murray, 2013).

Flood–health emergency risk management

Flood risk management usually includes actions to avoid floods, reduce flood risks, respond to floods and recover from floods (Plate, 2002). A range of measures have been adopted in many countries to avoid or reduce flood risks, including structural (physically engineered) interventions, as well as the development of multisectoral policy and organization measures (Thieken et al., 2007) .

Potential effects of climate change (e.g. more frequent extreme precipitation events) have been considered in catchment and river basin risk management approaches. The Intergovernmental Panel on Climate Change (IPCC) has identified increasing frequency and intensity of floods accompanied by economic losses to the people affected: those living in flood plains, close to rivers and waterways (IPCC, 2014). However, there is a noted high variability in the intensity of precipitation attributed to climate change based on global models.

But the key reason for such vulnerability is urbanization. A lack of functioning sewage systems, roads or other infrastructural needs mean that many flood-prone areas are urban, posing an inherent risk to many people. Economic losses have been attributed to the population's increased exposure to flood in both social and economic assets (Kundzewicz et al., 2013). Poor and marginalized people usually live in dwellings that cannot withstand

floods. The health impacts of flooding include infectious diseases, vector-borne diseases, burns and mental health conditions. Without any form of adaptation, health losses due to floods will escalate (IPCC, 2014).

The critical linkages between flood management, water resource management, public health, climate change and disaster risk reduction (DRR) are ill-defined and remain compartmentalized. There is a need to fill the knowledge gap of public health vulnerabilities in existing flood management practices and integrate health before, during and after the flood event. Integrated flood management supports this discourse and facilitates flood planning, preparedness, response and recovery activities to reduce environmental health hazards and protect human well-being (WMO, 2015).

Flood risk management is controlled by national/regional policies, supported by legislation. For example, the Water Framework Directive and a number of other directives cover flood risk management in the EU. Flood risk management usually embraces four phases: (i) long-term flood prevention; (ii) flood preparedness – the ability to ensure effective responses to the impact; (iii) flood response; and (iv) flood recovery. Responsibility for flood risk management varies within jurisdictions but in theory all levels of government bear some responsibility for flood risk management, throughout all phases. Effective flood risk management requires the active participation of governments at all levels and the community, including the health sector.

Emergencies can result from a wide range of hazards and some generic capacities are similar, regardless of the nature of the hazard. Some Member States in the Region have developed all-hazard national multisectoral disaster risk management plans and flood-specific subplans and some Member States have developed national health sector emergency risk management plans or emergency preparedness and response plans.

In this publication the authors propose the development of a flood–health emergency risk management plan that complements national health sector emergency risk management plans. The elements of this are derived from the health system building blocks, emergency management principles and core capacities of the IHR (WHO, 2008). Its ultimate aim would be to reduce flood–health effects. The new Health Emergencies Programme enables WHO Regional Office for Europe to better support countries in building their capacity to manage risks from health emergencies caused by all hazards, including natural disasters (WHO Regional Office for Europe, 2016).

The effectiveness of any plan depends on the ability of policy-makers and those responsible for implementation to deliver useful, timely, accessible, consistent and trustworthy information to their target audience, and especially to high-risk populations. Adoption, government approval and integration into existing plans are crucial steps. Implementation of the plan and its elements can be incorporated into a disaster-planning cycle as: longer-term development and planning; preparation; prevention; specific responses; recovery and monitoring; and evaluation. A national plan is helpful but implementation requires local-level components.

Developing a flood–health emergency risk management plan

The process for developing a flood–health emergency risk management plan includes:

- conducting a vulnerability and capacity assessment
- developing tasks and actions for priority areas in flood prevention and preparedness
- developing tasks and actions for priority areas in flood response
- developing tasks and actions for priority areas in flood recovery
- monitoring and evaluation.

Many of the capacities to manage flood–health risks should have been addressed in all-hazard health emergency risk management programmes. The flood–health emergency risk management plan should use as many of these common elements as possible and focus on measures required to address the specific risks of floods. Identified key actors should lead the planning process and key stakeholders in the development of the flood–health emergency risk management plan or subplan. One option is to establish a steering group with terms of reference and a project plan stating clear objectives, activities, consultative mechanisms, resources and monitoring and approval mechanisms. In some cases, the focus will be review and revision of existing plans. Some suggested tasks are listed below.

- Assess and map flood and tsunami health risks, indicating areas of the country or community with highest risks.
- Identify and analyse capacities for flood risk prevention, preparedness, response and recovery with respect to the assessed flood risk.
- Determine recommended actions for flood–health emergency risk management, assess resources and identify priorities for action.
- Draft plan including responsibilities assigned to respective stakeholder agencies.
- Conduct stakeholder consultations; pilot test, revise and finalize the plan.
- Submit plan for clearance by authorizing officials.
- Ensure implementation, regular monitoring and sustainable funding of the plan.
- Review and update plan regularly, or after exercises or operation; integrate flood subplan with all-hazard health emergency risk management plan; integrate flood–health plan with multisectoral flood emergency plan.

Developing a vulnerability and capacity assessment

For the health sector to be effective, it is very important to assess risks and understand the vulnerability of communities arising from damage to, and destruction of, infrastructure. These assessments of at-risk populations, geographical areas and infrastructure are even more important when long-term measures lack coordination between different sectors of government. Assessment of current capacities on search and rescue, health service delivery and mass-casualty management of health professionals and disaster managers gives a baseline for future human resource developments.

Baseline information on population health needs is required to determine the potential extra health needs imposed by flooding. Moreover, it may be necessary for high-risk geographical areas to develop their own local risk management approaches, linked to the wider and national emergency planning mechanisms. Preparation of integrated risk maps prior to flood events has been shown to be very useful (Sinisi and Aertgeerts, 2010). Such pre-event data can assist in the prioritization of interventions; identification of priority diseases to guide surveillance and early warning strategies; and development of health policies for floods.

Priority areas in flood prevention and preparedness

Planning for governance and coordination measures

While it is essential to assign a command control structure prior to an emergency, in most countries the lead emergency agency is neither the health ministry nor a specific department within it. Yet the health appropriate agencies should interact with all the stakeholders and organizations involved in emergency preparedness, response and recovery, including for floods. The concrete roles of each actor – their authorities, responsibilities and accountabilities, both organizational and individual – should be delineated in order to ensure seamless, effective, timely and efficient actions.

A range of standard operating procedures and guidelines are required to deal with flood events. This includes procedures to request, receive and coordinate support with international health partners in cases of large-scale emergencies that exceed national capacities. The lead emergency agency should cooperate with the health authority to ensure that systems are in place to receive, screen, register and task partners, and to anticipate, request and receive donations of medicines, health technology and consumables. Within this lead agency, the tasks and responsibilities required of every person concerned with flood response and recovery are set out and assigned to ensure efficiency and accountability. When a health cluster is formed, WHO should be the leading agency (Inter-Agency Standing Committee, 2015).

The health agency also needs to coordinate with actors outside the field of public health and medicine. Intersectoral involvement with different non-health actors allows increased flow of technical information from different agencies. Early warning systems from non-health agencies can be integrated in health planning for floods. Establishment of a coordinating mechanism with government agencies with capabilities to produce flood risk maps will enhance the health agency's early warning capacities. Moreover, planning for intersectoral teams to be deployed before and during a flood response has to be performed within flood preparedness activities. The cluster system is a specific means of coordinating within national or international agencies involved in disaster preparedness, response and recovery (Inter-Agency Standing Committee, 2015). The introduction of health considerations in the policies of different non-health agencies can be a product of intersectoral collaboration during flood preparedness following the principles of Health in All Policies (Stahl et al., 2006).

Member States in the WHO European Region share boundaries, coastlines and waterways, so coordination between health agencies of adjacent Member States and areas that are not regarded as part of a Member State can improve early warning systems for floods. Such collaboration between adjacent Member States and areas may also facilitate improvements in flood preparedness measures of individual Member States and the whole Region (UNECE, 2013).

Adopted in March 2015, the Sendai Framework supports the need for countries to have specific measures to build resilience through DRR. Targets were set to reduce global mortality, affected populations, economic losses and damage to infrastructure (including health and social services) and to increase cooperation between nations and the creation of national DRR strategies, early warning and disaster information management systems. Priority areas include research on disaster risk, governance in managing risk, investment and financing in DRR, and improvement of overall disaster preparedness, response and recovery. These are all in line with building resiliency from disasters and to build back better in disaster recovery and reconstruction (UNISDR, 2015).

Planning for emergency financing

A health financing system for flood events is to be planned for, in particular:

- budget for health programmes (e.g. staff, activities/services, health supplies, hospitals and infrastructure);
- contingency funds for emergency response and recovery;
- financial arrangements for emergency care (e.g. cost waiver policies, treatment of non-residents, medical repatriation);
- compensation systems (e.g. long-term care, insurance); and
- management of multinational or bilateral foreign aid.

Planning for health information systems and risk communication

Preparing for risk communication

It is vital to ensure that people have access to prior information on what they must do to keep healthy during floods. Such information requires preparation far in advance. Identification of multiple communication formats and tools must take account of the fact that the main communication lines from radio and TV very often do not work in flooded areas. Therefore, it is very important that people living in flood-prone areas receive the necessary information once or twice per year through generic information channels.

Risk communication is related to citizens' responsibility to play a role in flood mitigation. Community involvement and shared responsibility in the process of planning for preparedness, response and recovery may stimulate inhabitants to develop flood mitigation habits. Information disseminated to the community should include details of effective flood preparedness measures and ways to integrate these into daily life (Bubeck, Botzen and Aerts, 2012).

Establishment of clear communication mechanisms and flows is vital for risk communication. This includes providing the general public and specific audiences with information on what to do if a flood is imminent and when a flood has occurred; and safety and health measures during and after the flood. Emergency alert systems must have a planned communication flow and safeguards, with messages that are clear, concise, honest and reach their target audience (CDC, 2014; Infanti et al., 2013).

Vulnerable groups who require more health-related support include children; pregnant women; elderly people; refugees, internally displaced people and immigrants; sick people; people with disabilities; poor people; or inhabitants of highly populated high-risk urban

areas. Identification of these vulnerable groups in populations prior to a disaster provides a baseline understanding of additional health system needs. Information dissemination to these groups and their involvement in flood preparedness is part of the suggested risk communication strategy (Age and Disability Consortium, 2015; Runkle et al., 2012).

Ensuring a functional and targeted early warning system

Flood forecasting and warning systems are designed to predict and warn against events so that professional agencies can activate emergency plans in place, and households and businesses can take action to protect themselves and their families, employees, pets, livestock and belongings and assets. Such systems become more accurate as the event draws closer. However, flood-warning systems are effective only if they result in an appropriate response (Parker, Priest and Tapsell, 2009).

Current available flood warning systems are based on forecasts from meteorological services and environmental agencies' information on the risk of flooding. Such systems require certain characteristics if they are to be useful and functional.

- Links to existing flood alert mechanisms and trigger warnings and levels of response for relevant agencies in affected region.
- Identified early warning threshold for action (accurate and positive predictive value also for health systems) that is developed (where not available), up-to-date, tested and reliable – when available, this is the essential trigger of a flood response mechanism.
- Various alert levels accompanied by clear action points by assigned authorities – for example, health facilities need emergency plans that include, inter alia: horizontal and vertical evacuation; time considerations to evacuate people and equipment; communities' ability to transport and provide drinking-water and adequate sanitation; plans for evacuation shelters; and criteria for evacuation and responsibilities (Sinisi and Aertgeerts, 2010).

Planning for integrated health service delivery

Health service delivery

Health services include all services dealing with the diagnosis and treatment of disease, or the promotion, maintenance and restoration of health (WHO Regional Office for Europe, 2008). Public health, pre-hospital and facility-based clinical services must be well prepared to respond effectively in the event of an emergency with health consequences. They should have the capacity to scale up service delivery to meet increased health needs (e.g. through increasing bed capacity, establishing temporary facilities or mobile clinics, vaccination campaigns) and to take specific measures related to certain hazards (e.g. isolation of infectious cases).

Flooding may require health care services to expand beyond normal capacity to meet community demand. In the preparation of an event, it is very useful to develop health service delivery plans as these can be utilized to help determine preparedness priorities and plan preparedness activities. The Health Resources Availability Monitoring (formerly Mapping) System (HeRAMS) can be used as a guide to assess the health service components needed to function in response to, and recovery from, flooding (WHO, 2009, 2012a). The Hospital Safety Index provides an assessment tool to prepare health facilities for future hazard risks

(including floods) in order to maintain resilience throughout the stages of emergencies and disasters (WHO and PAHO, 2015). Furthermore, real-time simulation exercises are useful tools to ensure compliance and readiness of the health system – public health institutions, hospitals, community health centres and nursing homes – to implement measures to protect people in the event of a flood. Participants at the flood meeting held in Bonn in October 2015 suggested annual all-hazard simulation exercises (flood day) in which a flooding scenario is integrated for planning and to educate the public and health services.

Planning for integrated health services is essential and includes maintaining or increasing essential public health functions (Johns Hopkins Bloomberg School of Public Health, 2008; MSF, 1997; Menne and Murray, 2013; WHO, 2012a; WHO and United Nations High Commissioner for Refugees, 2015).

- Continuity of health care
 - child health
 - immunization programmes
 - sexual and reproductive health
 - mental health
 - noncommunicable diseases
 - other chronic conditions.
- Emergency care
 - general clinical services and essential trauma care
 - emergency maternal and neonatal care.
- Public health services
 - health education and promotion
 - control of communicable disease outbreaks
 - disease surveillance
 - management of dead and missing people
 - environmental health
 - water, sanitation and hygiene
 - vector control
 - waste management
 - chemical hazards and toxins
 - radiological hazards
- Food security, safety and nutrition
- Health security
 - societal measures (e.g. quarantine, school closures, cancellation of mass gatherings)
 - prevention and control at points of entry.

The flood meeting participants listed vital components of flood–health preparedness plans: floodproofing of health facilities and health services; stockpiling of medicines, technologies and other necessary supplies; provision of safe water; sanitation; food security; social

protection; and increased surge capacity. Special measures should target vulnerable population groups. Emergency medical response requires not only a good network of laboratories, including mobile laboratories, but also mobile teams (e.g. infectious diseases/surgery/X-ray) in a modular system with an operations centre in order to ensure fast mobile medical detachment and rapid redeployment.

Health infrastructure and logistics

During floods, health services can experience damage to infrastructure that disrupts normal activities (e.g. power and water supply interruptions, damage to vital equipment, disruption of internal and external communication systems, blocked transport systems and flooded ambulance stations).

Structural measures for health services and infrastructure build on technologies used in the domestic construction sector. These need to be implemented in advance, and include:

- infrastructure measures (e.g. wise investment in infrastructure, smart building design);
- protection of power supply infrastructure (e.g. generators kept dry by surrounding flood wall or by siting on higher floors);
- protection of emergency equipment (e.g. sited on higher floors);
- appropriate siting of sewage pipes within buildings; and
- wider availability of patient records (e.g. robust electronic patient record system accessible outside the principal facility).

Logistics management also requires advance planning, including (PAHO, 2001):

- medications (essential drugs), consumable health products and equipment
- water supply and distribution systems
- food
- warehousing, handling and transportation
- electricity
- telecommunications.

Human resources for health

Overall health system functioning relies on sufficient, adequately trained and resourced staff working within an organizational structure that allows the health system to identify, prevent and manage health risks effectively. Health services also rely on the provision of proven, safe and cost-effective health interventions.

Planning for staff training and capacity building (especially in areas identified as higher risk) should include certain important considerations:

- workforce development strategies;
- competency frameworks;
- curriculum development and course delivery (e.g. pre-service, in-service, university, community level);
- licensing and accreditation of staff/volunteers;

- surge capacity planning for personnel in mass casualty events; and
- safety and security of health staff (in workplace/field, in emergencies).

WHO Regional Office for Europe can support Member States in such capacity building for flood risk management for the health sector.

Water, sanitation and hygiene

Provision of safe water supplies, adequate sewage disposal and drainage are key considerations during flooding events. For the water and sanitation sector, the aim of preparedness programmes is to achieve a satisfactory level of readiness to respond to emergencies that may affect water and sanitation infrastructure and to strengthen the technical and managerial capacity of governments, organizations, institutions and communities to deal with them.

Introduced in 2004 in the WHO Guidelines for drinking-water quality, the water safety plan (WSP) approach is a core part of the framework for safe drinking-water. The WSP uses a comprehensive risk assessment and risk management approach to ensure the safety of drinking-water from the catchment area to the consumer end-point, describing actions to be undertaken for normal conditions to extreme events. As such, it can be used to plan for flood events (Sinisi and Aertgeerts, 2010).

Priority areas in response

Planning for governance and coordination measures during response

The maintenance and continued functioning of the command and control structure are essential for the functioning of organizations and health facilities facing floods. The focal point for health activities specifically for disasters aims to provide a system in which resources for health are used efficiently by the health ministry as well as all governmental and nongovernmental actors (PAHO, 2000). The lead health agency or focal point also interacts with international non-state actors such as United Nations agencies and international nongovernmental organizations (WHO, 2009). The continued guidance of the lead health agency during flood response is based on the protocols and procedures established during flood preparedness activities.

Health system coordination with other sectors and services

During an emergency response, coordination between sectors and services is of utmost importance. Several examples are outlined below.

- The military plays a significant role or is part of the lead coordinating group in severe emergencies. Its role includes evacuation and provision of emergency power, communication, food, water, medical assistance, transport, shelter and protective gear. This role is supported by many of the local authority functions such as police and fire services. Guidelines for the interaction of civil authorities and the military are provided by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA, 2007, 2015).
- Local authorities ensure the provision of shelter and alternative accommodation, blankets and clothes, food, water, sanitation and hygiene promotion. Often, they host departments responsible for social care, transport, housing and infrastructure. Additionally, they are

usually able to advise and utilize public services (e.g. schools and community centres) which may be needed for shelter or as improvised health or social care facilities. Local authorities have a role in ensuring the safety of infrastructure (e.g. buildings, bridges, fallen electric wires, fallen trees). Communications infrastructure is frequently the responsibility of the private sector.

- Civil protection service supports search and rescue, missing persons and maintenance of law and order and population control.
- Fire service mainly covers search and rescue and identifying and responding to fire risks.
- Transport services provide travel advice and detours if roads are closed, and ensure the safety and re-opening of transport networks.
- Water supply and sanitation services work with local authorities to ensure the provision of adequate and continuous water supply and sanitation services. They need to coordinate with the health sector to ensure provision of clean water and safe disposal of excreta. Fundamental maintenance activities within the system are solid waste disposal and cleaning of sewer conduits, stormwater tanks and other objects to maintain the maximum hydraulic capacity of the system. Additionally, water suppliers have a longer-term role in monitoring contamination of drinking-water supplies (Sinisi and Aertgeerts, 2010).
- Media and communication services establish a multi-agency communication team with the capacity to explore communication strategies to convey media messages to the general public, for example, via door to door information, radio, television and the internet (Rozeman and Mayeaux, 2006). Internal/professional communications infrastructure is maintained by a range of approaches including meetings, radio, emails and telephones (mobile, landline, satellite).
- Organizational arrangements focus on more coordinated and integrated forms of care provision (e.g. health network of integrated primary, secondary and tertiary care, pharmacies and social care).

Planning for health information systems and risk communication during response

Information management

Information management capacities will need to be strengthened to support risk/needs assessments; disease surveillance and other early warning systems; monitoring and evaluation; and public communications. It is important that information collection, analysis and dissemination are harmonized across relevant sectors, and mechanisms are in place to ensure that the right information gets to the right people at the right time.

In addition to disease surveillance, information on the following is often required rapidly during a flood event:

- health service damage
- damage to hazardous industrial facilities and sites (e.g. chemical pollution)
- water quantity and quality
- food quantity and quality
- chemical hazard management.

Risk communication

Effective communication, including risk communication, is a critical function during a flood emergency, especially when relating to other sectors, government authorities, the media and the general public. Real-time exchange of information, advice and opinions is vital so that everyone at risk is able to take informed decisions on mitigating the effects of the threat or hazard (e.g. disease outbreak) and taking protective and preventive action. Coordination among stakeholders is needed to avoid dissemination of conflicting information which can confuse people and fail to achieve the desired behavioural change. Harmonized communication strategies and risk communication messages prevent contradictory messages during an event.

Planning for integrated health service delivery during response

All services have the common goal of delivering an acceptable quality of care to preserve as many lives as possible in disasters with mass casualties and to prevent complications in those affected. Maintaining the capability of critical care areas in hospitals is an essential part of all disaster management planning, and expansion services must be planned effectively. Health services also need to develop contingency plans and plan for major influxes of patients, operational services that are not fully operational, and evacuation. Mobile field hospitals can provide back-up during incidents with mass casualties; some services that require specific attention are described in the following paragraphs.

Continuity of health care

Health care services have to continue to function during flood events. Basic services for child health; immunization programmes for vulnerable populations; sexual and reproductive health; noncommunicable diseases; diseases with chronic treatment consequences; and mental health have to be provided for the population affected by the flood. This includes continuity of access to essential drugs and medications (WHO, 2012a). It is important to mobilize and provide access to primary care to prevent acute exacerbation of chronic conditions, reducing premature deaths and unnecessary hospitalization (Kanter et al., 2015). The continuity of care needs of patients with chronic illnesses (e.g. diabetes, hypertension, tuberculosis, HIV, renal failure) or disabilities need to be considered as these are common conditions in the WHO European Region (IHME, Human Development Network, The World Bank, 2013; Miller and Arquilla, 2008).

Emergency care

Emergency medical services – including those for exacerbations of pre-existing conditions, general surgical care, trauma, orthopaedics, obstetrics and neonatal care – are important functions of a health system during emergency response. Continuation of the referral system among these services has to be maintained across community, secondary and tertiary care (WHO, 2012a).

Creation of a triage system to identify patients with minor injuries or non-acute medical complaints and fast track patients who need more urgent treatment can make more efficient and effective use of health services (Babar and Rinker, 2006). In order to avoid overwhelming emergency departments and hospital facilities, initial triage and treatment facilities should be set up in other locations (Lynn et al., 2006).

Provision of public health services

Several public services are required during an emergency: health promotion; control of infectious disease outbreaks; disease surveillance; management of dead and missing people; environmental health; food security and nutrition; and health security. Health promotion campaigns during disaster response can improve health conditions by implementing simple behaviours that prevent various infectious diseases (Johns Hopkins Bloomberg School of Public Health, 2008). Control of infectious diseases can be achieved by a variety of measures including access to clean water and sanitation; early diagnosis and treatment; adequate nutrition; and vector control. Monitoring of various infectious, noncommunicable diseases and trauma-related conditions provide timely information to enable managers to provide adequate supplies and take appropriate actions (MSF, 1997).

Surveillance is the systematic collection, analysis, interpretation and dissemination of information for public health. Floods significantly affect public health so robust surveillance is important during and after flooding to ensure rapid identification and control of infectious disease outbreaks and other health issues; to guide local and regional health service delivery; and to provide additional information about possible associations between floods and ill health. During humanitarian emergencies, an early warning alert and response network is often set up to support broad public health surveillance systems that may be underperforming, disrupted or non-existent, particularly in the acute phase of an emergency, while the routine systems recover from the effects of the disaster. Certain diseases must be considered priorities and monitored systematically (Iwata et al., 2013; WHO, 2012b).

The management of dead bodies is a sensitive topic with societal and cultural implications such as identification for legal issues and proper burial in line with cultural beliefs. The Pan American Health Organization provides guidelines to assist responders to take the appropriate actions (Morgan, Tidball-Binz and van Alphen, 2006).

Environmental health – including water, sanitation and hygiene (WASH); vector control; waste management; and chemical and radiological hazards – is a public health concern that requires multidisciplinary management. Suggestions on WASH measures are given in the *Guidance on water supply and sanitation in extreme weather events* produced by WHO Regional Office for Europe and the United Nations Economic Commission for Europe (Sinisi and Aertgeerts, 2010). Health security guidelines can be referenced from the WHO document: *International Health Regulations (2005)* (WHO, 2008).

Flood meeting participants listed important public health measures for flood response and recovery: rescue and evacuation (evacuation centres); surveillance (sanitary/hygienic/epidemiological); WASH (including waste management); disinfection, disinsection (pest control) and disinfestation (DDD); mental health; management of dead bodies; and care for vulnerable population groups (people with chronic illness, migrants, pregnant women).

Priority areas in recovery

Negative health outcomes continue to occur for many months after the initial flooding event. Mostly, these relate to contaminated land and water; dampness of homes and the stress of the initial event; loss and disruption to homes and social networks; and economic impacts. Health services need to continue to provide support and treatment to aid recovery, whilst other sectors have a role in reducing the length and nature of factors affecting stress.

During recovery, policies to promote population resilience to flooding must include practical support for flood victims, including advice and support on housing, insurance and finances; prompt re-housing; maintenance and strengthening of social networks; and the provision of appropriate psychological support (Reacher et al., 2004).

Planning for governance and coordination measures during recovery

The lead health agency's role in overall supervision and coordination includes the task of assigning roles to different state and non-state actors during the post-flood recovery stage. A variety of activities are assigned to the actors responsible, including those described below.

- Assessment of health impacts: covering epidemiological, hygiene and sanitation issues which affect the health of affected populations.
- Assessment and analysis of damage and losses: including physical damage to buildings, structures and communication links, including health facilities. This forms the basis for recovery and for improvement of future preparedness.
- Clean-up and decontamination of affected land and property: the health sector has a role in providing health advice regarding the clean-up process and any short-term and longer-term risks to health from flood contaminants (e.g. mould).

The lead health agency needs to provide information on particular hygiene aspects, including:

- control of and guidance on safety in utilization of building materials after the flood;
- public information on further health prevention measures;
- control and regulation of collection and disposal of animal cadavers, as well as related sterilization;
- identification of infectious diseases, isolation of causative agents, and surveillance;
- eradication of insect and rodent vectors;
- information on need for, and availability of, chemicals for sterilization;
- evaluation and monitoring of sanitation, sterilization and disease control activities.

Planning for health information systems and risk communication during recovery

The health sector has a role in the provision of health advice on the clean-up process and any short- and long-term risks to health from flood contaminants. Immediately after the flood, health professionals need to provide practical advice to people re-entering their homes, clean-up workers and deployed personnel. Thereafter, the health sector can help to track and minimize delayed long-term health outcomes such as mental health issues. As floodwater recedes, health professionals should undertake the tasks described below.

- Communicate with emergency services to ensure that people do not return home before it is safe to do so.
- Highlight and raise awareness of likely carbon monoxide poisoning cases among all health services.
- Release warnings and information to the general public about risks and the need for proper ventilation when using generators and dryers.

- Raise awareness of remaining threats to food and water safety from floodwater contamination of supplies and surfaces and encourage people to maintain hygienic and sanitary precautions until the clean-up is complete.
- Re-emphasize health messages after a flood event, especially:
 - good hand hygiene practices
 - boiling or chlorination of drinking-water
 - safe food preparation techniques
 - seeking early treatment in case of fever
 - personal protection against vectors and zoonoses.

The safety requirements for clean-up personnel should also be reiterated.

- Generally, clean-up crews should wear full personal protective equipment, including waterproof safety boots, hard hats, goggles and work gloves. This is essential when dealing with chemical spills or sewage contamination. Ear plugs should be used when necessary.
- Every worker should undergo at least basic training on likely hazards in post-flood clean-up work.
- Clean-up workers should be vaccinated against tetanus if their vaccination status is not up to date.
- Even minor wounds, burns, cuts and injuries should be treated immediately.

Planning for integrated health service delivery during recovery

Health services delivery

Health care system recovery involves collaboration with other community partners to develop efficient processes and advocate for the rebuilding of public health, medical and mental/behavioural health systems to at least a level of functioning comparable to pre-incident levels, and improved levels where possible. The aim is an effective and efficient return to normalcy or to a new standard of normalcy in the provision of health care to the community. To integrate this capability, public health and health care emergency planners should coordinate recovery plans that aim to revitalize and rebuild the public health and medical system. The recovery stage of a disaster is an opportunity to improve the health status of the population through improving the health service delivery available. The build back better approach is suggested as a means to promote communities' resiliency to handle subsequent natural hazards such as floods (UNISDR, 2015).

Floods can have a strong effect on people's mental health. Mental distress is the most common, therefore it is important to:

- monitor closely the number of people coming forward for psychosocial mental health care and facilitate access to available mental health services;
- expect an upsurge in stress-related behaviour, particularly in children, during heavy rain and plan to provide the necessary capacity to meet demand; and
- have a stepped approach to mental health intervention – in particular, people with problems persisting four weeks after the event should be assessed to identify any need for more specialized mental health care (WHO and United Nations High Commissioner for Refugees, 2015).

Generally, post-flood psychological assistance should be provided by psychologists and/or trained personnel. Several specific issues should be kept in mind.

- People should be encouraged to seek assistance if psychological symptoms aggravate or persist.
- Mental health of responders and health care personnel should be considered, and may be addressed through the appropriate course determined by field psychologists.
- Long-term mental health issues (such as depression or post-traumatic stress disorder) should be monitored in affected communities.
- Prompt restoration of communities and social cohesion is important in the context of prevention of long-term mental health outcomes of disasters.
- If considered necessary, field workers could receive training in psychological first aid (WHO and United Nations High Commissioner for Refugees, 2015).

Health infrastructure and logistics

Any damaged water defence structures must be repaired to at least the same standard as before the flood, and preferably strengthened to withstand even greater flood events. Rehabilitation is an opportunity to improve the physical and structural functionality of buildings: serious inundation may be averted by building retaining walls and gates; function may be maintained by including emergency water and isolated temporary electricity supplies in health facilities. Monitoring and surveillance activities during and after a flood include processes to enhance surveillance and reporting of deaths, injuries and illnesses.

The priorities of the Sendai Framework include promotion of the resiliency of health facilities and other vital social services in the event of a disaster. Ideally, resilient structures will be built from the start, however, recovery and reconstruction of these facilities post-disaster may provide an opportunity to build back better (UNISDR, 2015).

The Hospital Safety Index is another aid to ensuring the resilience of health facilities during and after floods. This diagnostic tool provides an evaluation of a facility to enable health ministries and hospital managers to maintain continuity of services and avoid interruptions in health care during and after an emergency event. It also provides cost-effective measures to improve health facilities' capacity to withstand emergency events such as a flood (WHO and PAHO, 2015).

Monitoring and evaluation

Evaluation can follow all aspects of implementation of the plans and be used to report to governing bodies on progress made and problems encountered. It can also be used to foster and support, at different levels, periodic evaluation of the national implementation of the flood-health emergency risk management plan with the aim of strengthening the managerial process for national health development. In general, the development of an evidence base to promote health and reduce health inequalities depends on high-quality evaluations that can support decision-makers with information about the types of programmes that can be developed and implemented to ensure the most effective use of resources.

It is important to:

- ensure that activities are having the intended effects (effectiveness);
- determine whether activities are cost effective (efficiency);
- establish whether activities are acceptable to the target population (social acceptability);
- ensure that evaluation features at all stages of the planning, development, implementation and review of programmes.

However, various factors make it extremely difficult to evaluate flood–health action plans:

- wide variations in the structure, partner agencies and specific interventions deployed during a flood event;
- requirements may change from year to year in response to events and the changing priorities of partner agencies; and
- flood events are relatively rare within any particular geographical area.

As a result, there is little published information on formal (quantitative or qualitative) assessments of the effectiveness of systems as a whole, or on individual intervention measures. To develop the evidence base for flood–health protection and to ensure that plans are as effective and efficient as possible, it is essential that flood–health action plans are evaluated and that the evaluations are published.

Like heat–health action plans, flood–health action plans need to target the most vulnerable in society in order to ensure that they do not suffer excess morbidity or mortality during flood events. Hence, it is recommended that flood–health action plan evaluations include an assessment of their success in reaching these groups.

Simulation exercises also support the monitoring and evaluation of flood preparedness plans. Such activities indicate whether flood preparedness plans are up to date and appropriate in country specific or local settings. They also reveal areas in need of improvement (PAHO, 2000).

Flood meeting participants reported that monitoring and evaluation during and after flood events allow for adjustment of interventions and improvement of plans and measures. This entails continued follow-ups for health impacts and short-, medium- and long-term goals to detect a range of effects. It also includes debriefs, surveillance and research for the identification and discussion of lessons learnt. Three important pillars for monitoring and evaluation have been identified:

1. integrated information system for collection of data and their analysis
2. identification of key elements of a response and an appropriate/matching checklist
3. specific form of reporting with a defined set of indicators.

International and regional policy developments

The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted by representatives from 187 United Nations Member States in March 2015. It has four priorities: (i) understanding disaster risk; (ii) strengthening disaster risk governance; (iii) investing in DRR for resilience; (iv) enhancing disaster preparedness for effective response and to build back better in recovery, rehabilitation and reconstruction. Global, regional, national and local activities were set for each of the priorities (UNISDR, 2015).

The United Nations' sustainable development goals (SDGs) support the need for early warning and DRR systems, adaptation to climate change, strengthened resilience, adequate facilities and infrastructure and appropriate policies (United Nations, 2016).

As the United Nations agency for health, WHO plays an essential role in supporting Member States' preparation for response to, and recovery from, emergencies with public health consequences. WHO also has obligations as Health Cluster lead agency of the Inter-Agency Standing Committee (IASC); to the IHR (2005); and to other international bodies and agreements related to emergency response (WHO, 2008, 2009). WHO follows an emergency response framework which clarifies the organization's roles and responsibilities during disaster response and enables the organization to use a common approach across all regional offices. This framework includes core commitments, assessments, emergency grading, standards, critical functions, procedures and policies in emergency response (WHO, 2013). The new WHO Health Emergencies Programme aims to help countries prepare for, prevent, respond to and recover from emergencies quickly, in a more predictable, dependable and accountable way, whether these are caused by disease outbreaks, disasters or conflict. The common structure reflects WHO's major functions in health emergency risk management (WHO Regional Office for Europe, 2016):

- infectious hazards management;
- country health emergency preparedness and the IHR (2005);
- health emergency information and risk assessments including event detection and verification, health emergency operations monitoring, and data management and analytics;
- emergency operations including incident management functions, operational partnerships and readiness, operations support and logistics; and
- emergency operations management, administration and external relations.

Entering into force on 15 June 2007, the IHR require countries to report certain disease outbreaks and public health events to WHO. Building on WHO's unique experience of global disease surveillance, alert and response, the IHR define the rights and obligations of countries to report public health events and establish a number of procedures that WHO must follow in its work to uphold global public health security. The IHR cover a wide variety of public health events – defining the term event as a manifestation of disease or an occurrence that creates a potential for disease; and disease as an illness or medical condition that presents or could present significant harm to humans, irrespective of origin or source. In addition, the IHR define a public health risk as the likelihood of an event that may adversely affect the health of human populations, with emphasis on those that may spread internationally or may present a serious and direct danger, and potentially require a coordinated international response. The definitions of these terms are the building blocks of the expanded surveillance and response obligations of Member States and WHO under the IHR (WHO, 2008).

The challenge of meeting the IHR requirements requires commitment and a willingness to change. Seven areas of work are set out to assist countries to meet the new obligations, each area of work having a specific goal that contributes to the overarching goal of international public health security. In addition, each area of work is the subject of one or more detailed implementation plans.

The seven areas of work for IHR implementation

1. Foster global partnerships.
2. Strengthen national disease prevention, surveillance, control and response systems.
3. Strengthen public health security in travel and transport.
4. Strengthen WHO global alert and response systems.
5. Strengthen the management of specific risks.
6. Sustain rights, obligations and procedures.
7. Conduct studies and monitor progress.

The Protocol on Water and Health to the 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes was adopted at the Third Ministerial Conference on Environment and Health in 1999 and entered into force in 2005. The Protocol is the first legally binding agreement to ensure safe drinking-water and prevention, control and reduction of water-related diseases in the WHO European Region. It has been adopted and ratified by 36 countries. The goal of the Protocol is to protect human health and well-being through improved water resources management and by prevention, control and reduction of water-related diseases as well as detection, contingency planning and response to outbreaks. Article 8 of the Protocol requires parties to establish, improve and maintain a comprehensive national and/or local surveillance and early warning system; to identify outbreaks or incidents of water-related diseases, including those resulting from extreme weather events; and prepare contingency plans in response to such outbreaks and incidents. The guidance on water supply and sanitation in extreme weather events was developed under the Protocol and adopted at the second session of the Meeting of Parties in 2010. It responds to short-term critical situations. The guidance on water and climate adaptation was developed under the Water Convention jointly with the Convention's Task Force on Water and Climate, and adopted by Parties of the Convention (UNECE, 2013; UNECE and WHO Regional Office for Europe, 1999).

The Commitment to Act on Climate Change was approved at WHO's Fifth Ministerial Conference on Environment and Health, Parma, 2010. One objective calls for further strengthening of early warning and intersectoral collaboration. The Parma Declaration underlines the need to strengthen health, social welfare and environmental systems and services to improve their response to the impacts of climate change in a timely manner – for example, to extreme weather events – and urges development of early warning systems (WHO Regional Office for Europe, 2010).

A number of EU Directives call for flood management. Directive 2007/60/EC on the assessment and management of flood risks requires EU Member States to assess all water courses and coastlines for risk of flooding; to map the flood extent and assets and humans at risk in these areas; and to take adequate and coordinated measures to reduce this flood risk (European Commission, 2007; Knights et al., 2011). This Directive also reinforces the rights of the public to access this information and to have a say in the planning process. Member States were required to carry out a preliminary assessment to identify the river basins and associated coastal areas at risk of flooding by 2011; to draw up flood risk maps for such zones by 2013; and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive applies to both inland waters and

coastal waters across the EU. The Directive was carried out in coordination with the Water Framework Directive, notably through coordination of flood risk management plans and river basin management plans and of public participation procedures in the preparation of these plans. All assessments, maps and plans prepared were expected to be available to the public. Furthermore, EU Member States coordinate flood risk management practices in shared river basins (including with third countries) and take into consideration long-term developments (including climate change) as well as sustainable land use practices in the flood risk management cycle addressed in this Directive (European Commission, 2007).

Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health and repealing Decision No 2119/98/EC covers the coordinated EU response to, and preparedness for, possible pandemics. It institutionalizes joint procurement and standards in disease surveillance among Member States and covers risk assessment, early warning systems on possible cross-border threats, and monitoring and evaluation activities (European Commission, 2013).



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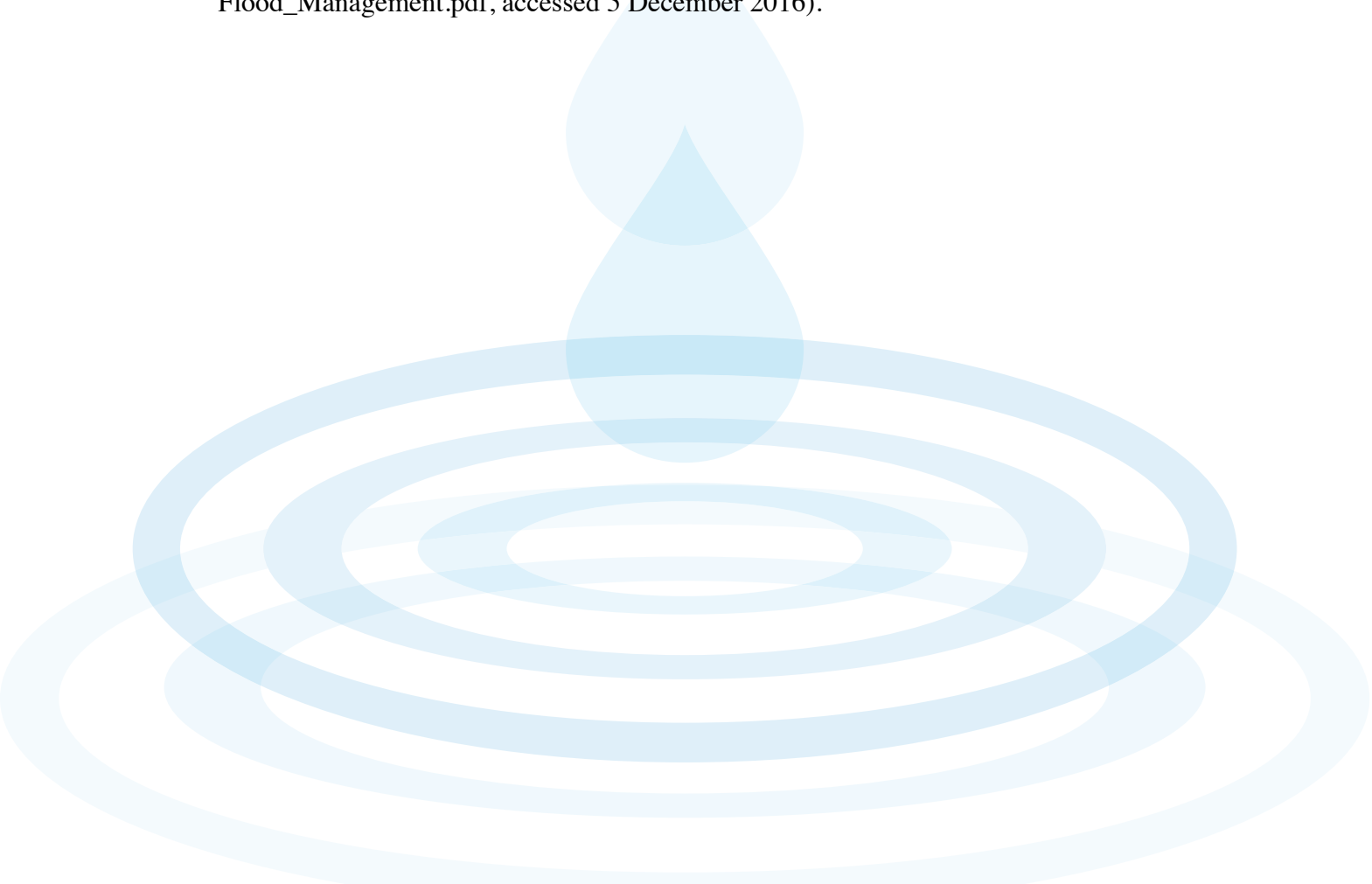
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Annex I. Definitions

Disaster. A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster risk. A function of hazard, exposure and vulnerability. Normally expressed as the probability of loss in a given period of time.

Disaster risk reduction. Describes the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Early warning system. Set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

Evaluation. Systematic assessment of the relevance, adequacy, progress, efficiency or effectiveness of a policy, programme or project, in relation to its intended aims and objectives.

Exposure. Describes people, property, systems or other elements present in hazard zones that are thereby subject to potential losses.

Flood. Increase of water that has a significant impact on human life and well-being.

Hazard. Refers to natural (or physical), technological or biological phenomena which have the potential to cause harm and damage.

Health service. Any service (i.e. not limited to medical or clinical services) aimed at contributing to improved health or to the diagnosis, treatment and rehabilitation of sick people.

Health system. (i) All the activities whose primary purpose is to promote, restore and/or maintain health; (ii) the people, institutions and resources, arranged together in accordance with established policies, to improve the health of the population they serve, while responding to people's legitimate expectations and protecting them against the cost of ill health through a variety of activities whose primary intent is to improve health.

International Health Regulations (IHR). International legal instrument that is binding on 196 countries across the globe, including all Member States of the World Health Organization. Their aim is to help the international community prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide.

Preparedness. Knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Prevention. Outright avoidance of adverse impacts of hazards and related disasters. Prevention (i.e. disaster prevention) expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance.

Recovery. 1. Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. 2. Longer-term effort to: (a) reconstruct and restore the disaster-stricken area, e.g. through repairing or replacing homes, businesses, public works and other structures; (b) deal with the disruption that the disaster has caused in community life and meet the recovery-related needs of victims; and (c) mitigate future hazards.

Response. Provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Risk assessment. Methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability and capacities that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

Vulnerability. Describes the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. In relation to people, vulnerability can be defined as the diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a hazard. People differ in their exposure to risk and the factors that increase their exposure include poverty, inequality and discrimination related to gender, age, ethnic or other identity, (dis)ability, etc. Through their relative poverty and social and economic exclusion, women are often more vulnerable to hazards than men.

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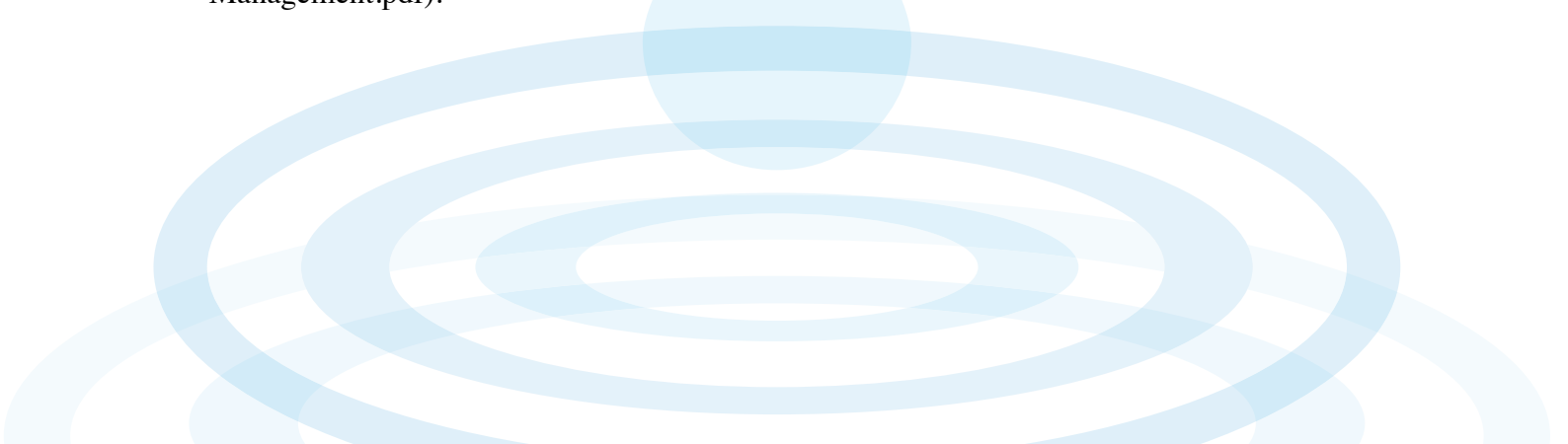
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1. Health effects of floods

Health effects on people exposed to floodwater include:

- drowning from walking or driving through floodwater;
- injuries from:
 - contact with debris and submerged objects in floodwater
 - falling into hidden manholes
 - trying to move possessions during floods
 - building collapse and damage
 - electrocution;
- diarrhoeal, vector- and rodent-borne diseases;
- respiratory diseases;
- skin infections;
- eye infections;
- chemical poisoning, including carbon monoxide poisoning from generators used for pumping and dehumidifying;
- stress, short- and longer-term mental health disorders;
- negative health effects linked to overcrowding.

Effects can occur through:

- damage to health care infrastructure, leading to:
 - loss of access to essential care
 - loss of access to, and failure to obtain, continuing health care;
- water shortages and contamination due to loss of water treatment works and sewage treatment plants;
- damage to water and sanitation infrastructure;
- damage to, or destruction of, property and vital community facilities;
- damage to crops;
- disruption of food supplies;
- disruption of livelihoods and income;
- population displacement;
- length of flood recovery and fear of recurrence;
- stress from dealing with insurance claims and refurbishing properties.

Source

Menne B, Murray V, editors (2013). Floods in the WHO European Region: health effects and their prevention. Copenhagen: WHO Regional Office for Europe (<http://www.euro.who.int/floods-in-the-who-european-region>, accessed 5 December 2016).

2. Vulnerable populations and factors that increase vulnerability

Vulnerable population groups include:

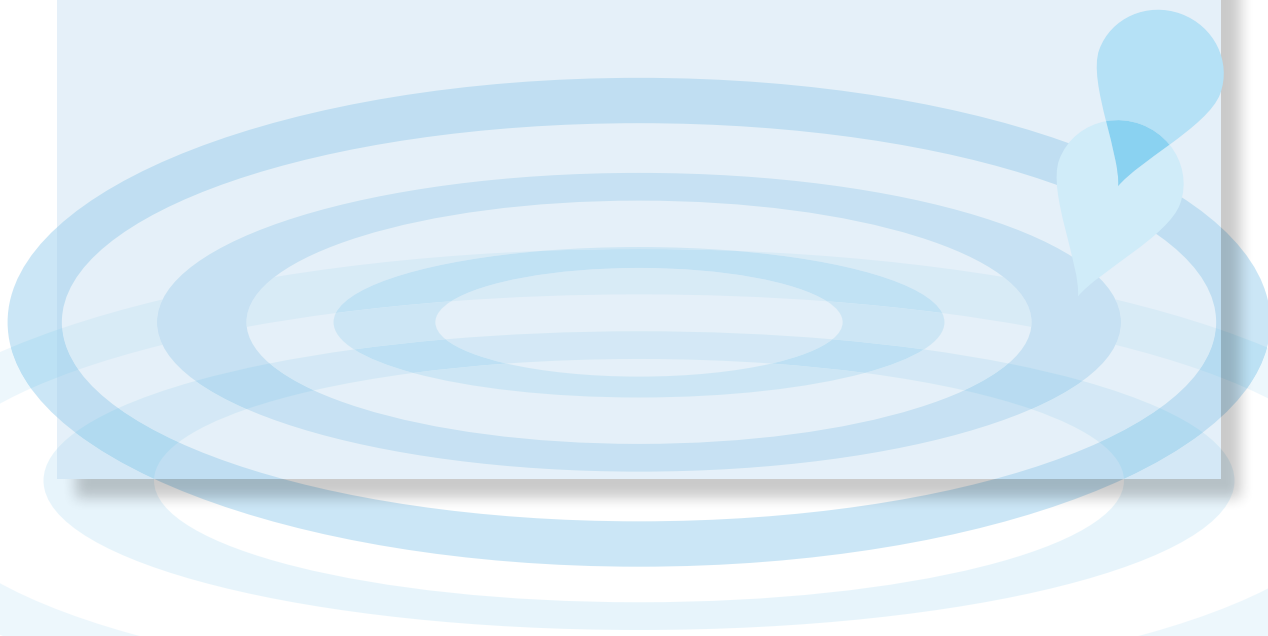
- pregnant women
- people with chronic illnesses
- people who rely on home care
- elderly people
- people with physical, sensory and cognitive impairments
- tourists
- homeless people
- people from minority populations
- socially isolated people.

Factors that increase vulnerability:

- limited physical capacity
- limited mobility
- reliance on important medication and/or home care
- reliance on regular care at a health facility
- weak social networks
- poor flood awareness
- lack of resources
- lack of access to information and warnings
- staying in buildings at high risk from floods.

Source

Menne B, Murray V, editors (2013). Floods in the WHO European Region: health effects and their prevention. Copenhagen: WHO Regional Office for Europe (<http://www.euro.who.int/floods-in-the-who-european-region>, accessed 5 December 2016).



3. Structural and non-structural measures

A range of measures have been adopted in many countries to avoid or reduce flood risks. These include structural (physically engineered interventions) and non-structural (policy and organization) measures. Examples of structural measures include land-use management; flood defences and barriers; and design and architectural strategies. Non-structural measures include flood insurance, development policies, zoning laws, flood-plain regulations, building codes, flood-proofing, tax incentives, emergency preparedness, flood forecasting and post-flood recovery (Michel-Kerjan, 2010). However, the best preventive method is still to avoid building in flood-prone areas. Examples of structural and non-structural measures are mentioned below, by objective.

Prevent floodwaters reaching settlements through use of:

- spatial planning, including flood-plain and land use management;
- town planning (e.g. ensuring high-level access roads and hospitals in raised areas);
- tree planting;
- abandonment, realignment and managed floodwater retreats;
- space for amenities (e.g. permeable surfaces);
- resilient water supply, wastewater treatment plants and sanitation systems.

Control water sources and water flow in utility-managed water supplies and in small-community water supply systems (e.g. raising tube and dug wells to protect against contamination from flooding) through use of:

- flood-proofed sanitation technology;
- sustainable drainage systems;
- dredging of water courses;
- dikes, levees and barriers;
- policy and law to control water sources and flow;
- storm-water management – structural methods include filter drains, porous surfacing, swales and retention or balancing ponds, as well as constructed wetlands.

Protect buildings and infrastructure in flood-prone areas through use of:

- flood avoidance measures (e.g. buildings in higher locations, relocation);
- flood resistance and resilience measures for residential properties (e.g. to minimize or prevent entry of floodwater, avoid or minimize damage from any floodwater that does enter and prevent permanent damage) including:
 - additional investment in permanent resistance (i.e. permanent flood-proof doors, resilient windows and frames, airbrick covers, concrete/sealed floors, resilient plaster (up to 1m), resilient kitchen, raised electrics and appliances),

- manually installed door guards and airbrick covers, sump/pump and remedial works to seal water entry points,
- permanent flood-proof external doors, automatic airbricks and external wall render/facing, sump/pump and remedial works to seal water entry points;
- flood-proofing buildings, using techniques such as:
 - elevation – raising inhabited parts of buildings above flood level through use of stilts or by using landfill to make basements watertight,
 - wet flood-proofing – make parts of the building uninhabitable but resistant to flood damage and allow water to enter them and run through during a flood,
 - dry flood-proofing – finishing walls with waterproof cement-type plastering to seal the property and prevent water entry,
 - floodwalls – built around a building to prevent floodwater coming near,
 - providing backups – e.g. higher resilience buildings that can be used to provide refuge.

Facilitate recovery of costs of flood-related damage by ensuring the availability of domestic insurance at affordable prices.

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4. Structural measures for health services

Structural measures for health services and infrastructure build on technologies used in the domestic construction sector. However, a few issues require particular attention. It is important to:

- protect power supply infrastructure (e.g. keep generators dry by surrounding with a flood wall or siting on higher floors);
- protect emergency equipment (e.g. site on higher floors);
- site sewage pipes appropriately within buildings;
- ensure access to patient records (through a robust electronic patient record system that can be accessed outside the principal facility).

Generic building structural measures include:

- elevation: raising inhabited parts of a building that are at flood level on stilts or using landfill to make basements watertight;
- wet flood-proofing: making parts of a building uninhabitable but resistant to flood damage and allowing water to run through it during a flood;
- dry flood-proofing: sealing a property to prevent water from entering (e.g. using portable floodgates or flood boards and non-return valves);
- flood walls: constructing a wall around a building to prevent floodwater from coming near;
- relocation or demolition: moving a timber house to higher ground or rebuilding a structure that is damaged beyond repair.

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5. Flood early warning system

Early warning systems are designed to make a prediction of flooding risk based on monitoring rainfall, river levels, sea and tidal conditions (Environment Agency 2009). Flood warning systems are often integrated within the weather forecasting system of a country or region, because their data are required for accurate predictions.

Meteorological forecasts of heavy precipitation and flood events are the basis for flood–health action plans. Considered alongside expected impacts on the population and on infrastructure and services, they trigger the various alert levels of a response plan and the respective measures. Flood warnings are important to allow people and institutions to prepare themselves or their properties for floods and make evacuation plans where necessary.

Table 1 illustrates an example from the United Kingdom.

Table 1. Example of flood warning codes issued by the United Kingdom Environment Agency

Warning symbol	Warning code	What it means	When it is used	What to do
	Flood alert	Flooding is possible. Be prepared.	Two hours to two days in advance of flooding	Be prepared to act on your flood plan. Prepare a flood kit of essential items. Monitor local water levels and the flood forecast on our website.
	Flood warning	Flooding is expected. Immediate action is required.	30 min to 1 day in advance of flooding	Move family, pets and valuables to a safe place. Turn off gas, electricity and water supplies if safe to do so. Put flood protection equipment in place.
	Severe flood warning	Severe flood warning. Danger to life.	When flooding poses a significant threat to life	Stay in a safe place with a means of escape. Be ready should you need to evacuate from your home. Cooperate with the emergency services. Call 999 if you are in immediate danger.
	Warnings no longer in force	No further flooding is currently expected in your area	When river or sea conditions begin to return to normal	Be careful. Flood water may still be around for several days. If you have been flooded, ring your insurance company as soon as possible.

Source: Environment Agency, 2012.

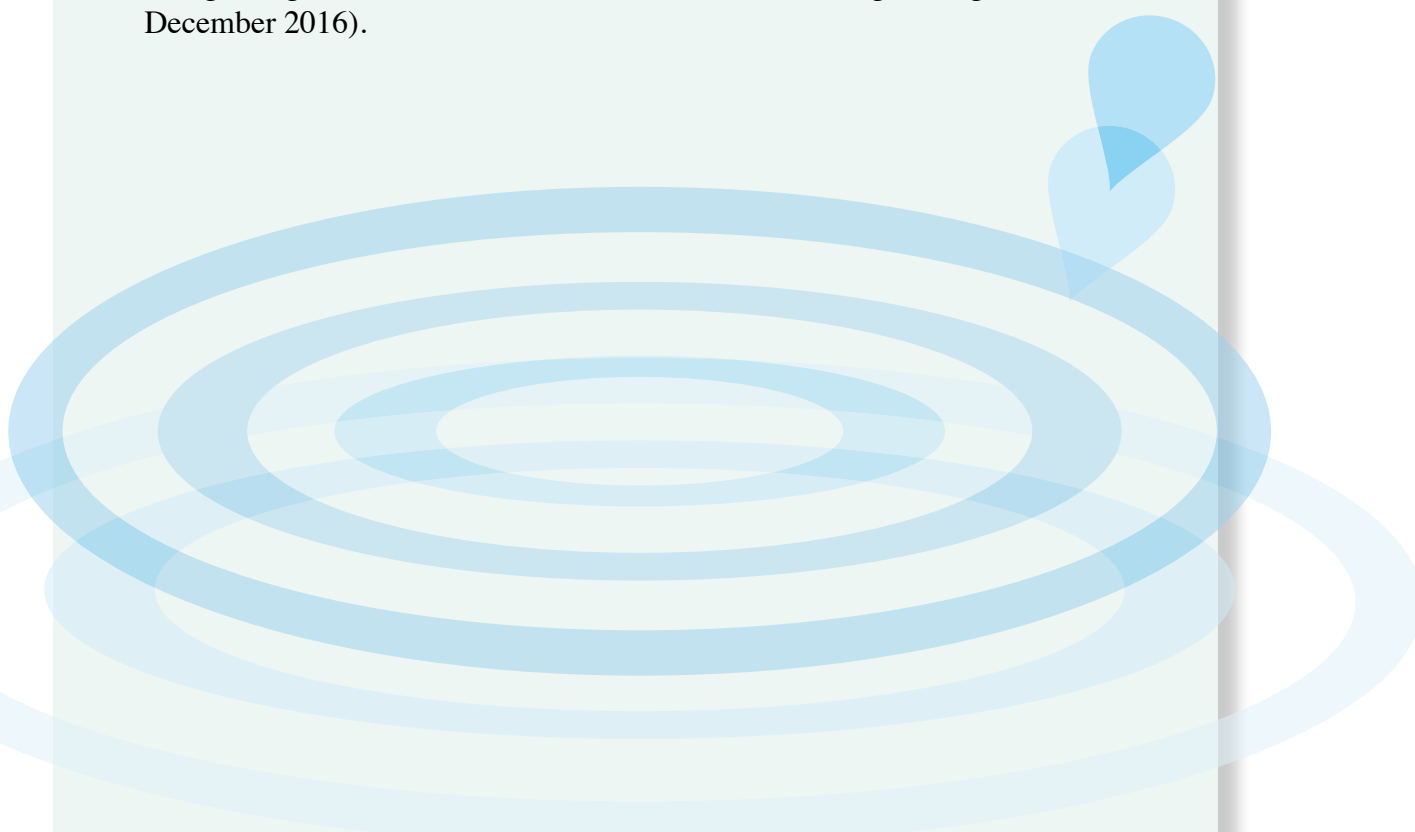
Several European and global flood systems are available.

- The European Flood Awareness System (EFAS, 2017) is an early flood warning system complementary to national and regional systems. It provides the national institutes and the European Commission with information possible river flooding to occur within the next three or more days. Flood warning is a Member State responsibility so only archived flood warnings can be made publically available. Real-time warnings are made available to national partner institutes only.
- *Manual on flood forecasting and warning* (WMO, 2011) provides the basic knowledge and guidance to develop or set up an appropriate and tailored system for any case that requires a flood forecasting and warning system. The aim is to provide a succinct but comprehensive overview of the basic knowledge and information that the relevant personnel of national meteorological or hydrometeorological services or other flood management services would require.

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6. Flood risk assessment checklist

Hazard analysis

- Identification of hazard(s).
- Assessment of potential magnitude of health consequences and likelihood of occurrence (e.g. what is the worst case scenario?).
- Assessment of scale – geographical and temporal (e.g. where is it likely to occur?).

Vulnerability analysis

- Analysis of vulnerability to hazards of floods among individuals, populations and infrastructures (e.g. water supply and sanitation services).
- Vulnerability mapping (e.g. who would be most affected and how?).
- Required information:
 - detail on land use and economic value of different areas or industrial activities
 - geographical distribution of the population, including vulnerable groups
 - communication mechanisms and emergency and rescue operations available
 - health and social information (e.g. food, medicine and social care provision)
 - maps showing dwellings as well as infrastructure (e.g. hospital and social care buildings).

Capacity analysis of other sectors

- Evaluate water and sanitation sector's capacities in terms of:
 - infrastructures' vulnerability to flooding;
 - adequacy of emergency response procedures/protocols to secure sufficient supplies of safe drinking-water and/or safe disposal of wastewater under emergency conditions; and
 - communication protocols with local health offices to ensure timely advice to affected communities.

Evaluation of emergency services

- Set objectives, timelines and expected outcomes.
- Characterize exposure to flooding, including:
 - national, subnational or community vulnerability;
 - other health determinants in relation to flooding such as socioeconomic status or behaviour.
- Inventory existing actions available in health and other sectors.

- Assess future risks:
 - describing potential additional health risks from future climate change or more frequent and intense precipitation;
 - describing trends expected to influence flood-related health outcomes;
 - describing projected increases in flood events and extreme precipitation;
 - prioritizing effects.
- Identify suitable prevention and response mechanisms:
 - inventorying and prioritizing possible adaptation options;
 - assessing potential barriers to implementation.
- Develop evaluation criteria and performance management protocols, including protocols for:
 - evaluating adaptation options, including economic costs;
 - monitoring health outcomes over time.

Some key questions for risk assessment

- How serious is the threat?
- How urgent is the threat?
- What risks are communities exposed to (e.g. locations in flash-flood areas or landslide-prone areas; flood risk and return periods)?
- Are health and social services located in flood-prone areas?
- What structural and non-structural protection measures are in place?
- What local/regional/national/international coordination mechanisms are in place?
- Do health services, social services, water services, transportation methods and people have enough protection from what is currently available? Are they insured?
- What evacuation routes and temporary health services are available?
- Are emergency health services possible?
- Are public health services able to continue their functions and increase their activity level?
- How should response be prioritized?
- Who does what and when?
- What is the health vulnerability to flooding?
- What regulations cover international assistance/rules of engagement for external agencies?
- Is a dedicated staff/unit available to coordinate eventual development and operational roles at different administrative levels?
- Is there a budget for unit staff and programmes?
- Are organizational response and recovery plans available? Is staff health and welfare included?
- Are regular exercises or simulations carried out?

Health and social system capacity to manage health risks of an event

The WHO checklist (WHO Regional Office for Europe, 2011) can help to ensure:

- continuity of essential services
- well coordinated implementation of hospital operations at every level
- clear and accurate internal and external communication
- swift adaptation to increased demands
- effective use of scarce resources
- provision of safe environments for health care workers
- public health operations
- health infrastructure.

Resource needs

- human
- financial
- equipment and medical treatment
- vaccination.

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7. Preparedness for risk communication

Emergency risk communication is an integral part of health crisis response

Effective emergency risk communication (ERC) can contribute to public resilience and crisis control when a health crisis challenges a country. ERC comprises two components.

1. Operational communication between responders and stakeholders/donors – ensures that stakeholders are aware of the situation and of measures taken to address it at each stage, and are able to take informed decisions.
2. Communication with the public, between responders and the affected populations – ensures that the public is promptly and regularly informed about the situation; measures taken to address it; contacts and health care centres; and public health advice.

When a crisis hits, the affected country becomes a communication hub which can cause up to a tenfold increase in the communications workload. ERC is needed for surge capacity and to make use of all partners' resources.

ERC entails key core capacities

ERC improves transparency and coordination and ensures not only effective information delivery but also public and stakeholder participation in the emergency response. This increases people's trust in the responders as well as their acceptance of guidance. An ERC plan should be ready to be activated in emergencies, encompassing:

- early, transparent and regular communication;
- coordination among sectors, levels and partners in ERC;
- talking with the public to understand their perceptions, beliefs and practices and inform formulation of effective strategies and messages;
- identifying the most effective channels that the audience can access, including media, social media, web, telephone lines and text messages, leaflets and posters, health care workers, opinion leaders, door-to-door visits; and
- monitoring and evaluating throughout the process and at its conclusion in order to inform adjustments in the ERC strategy.

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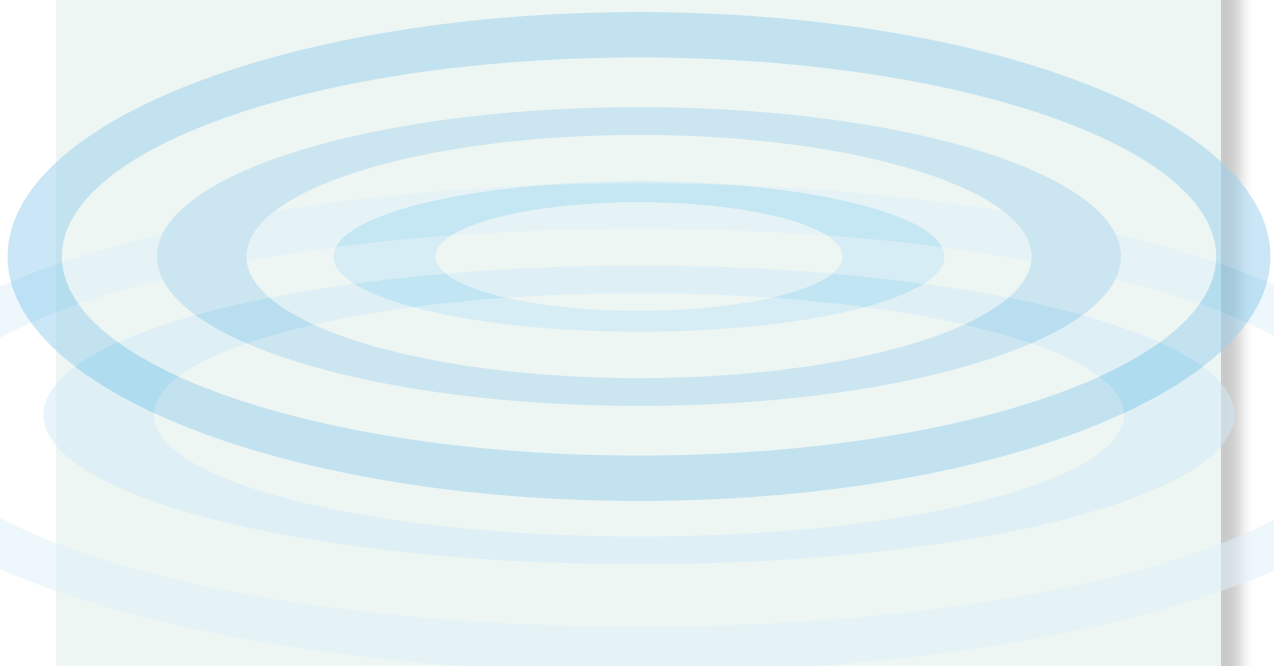
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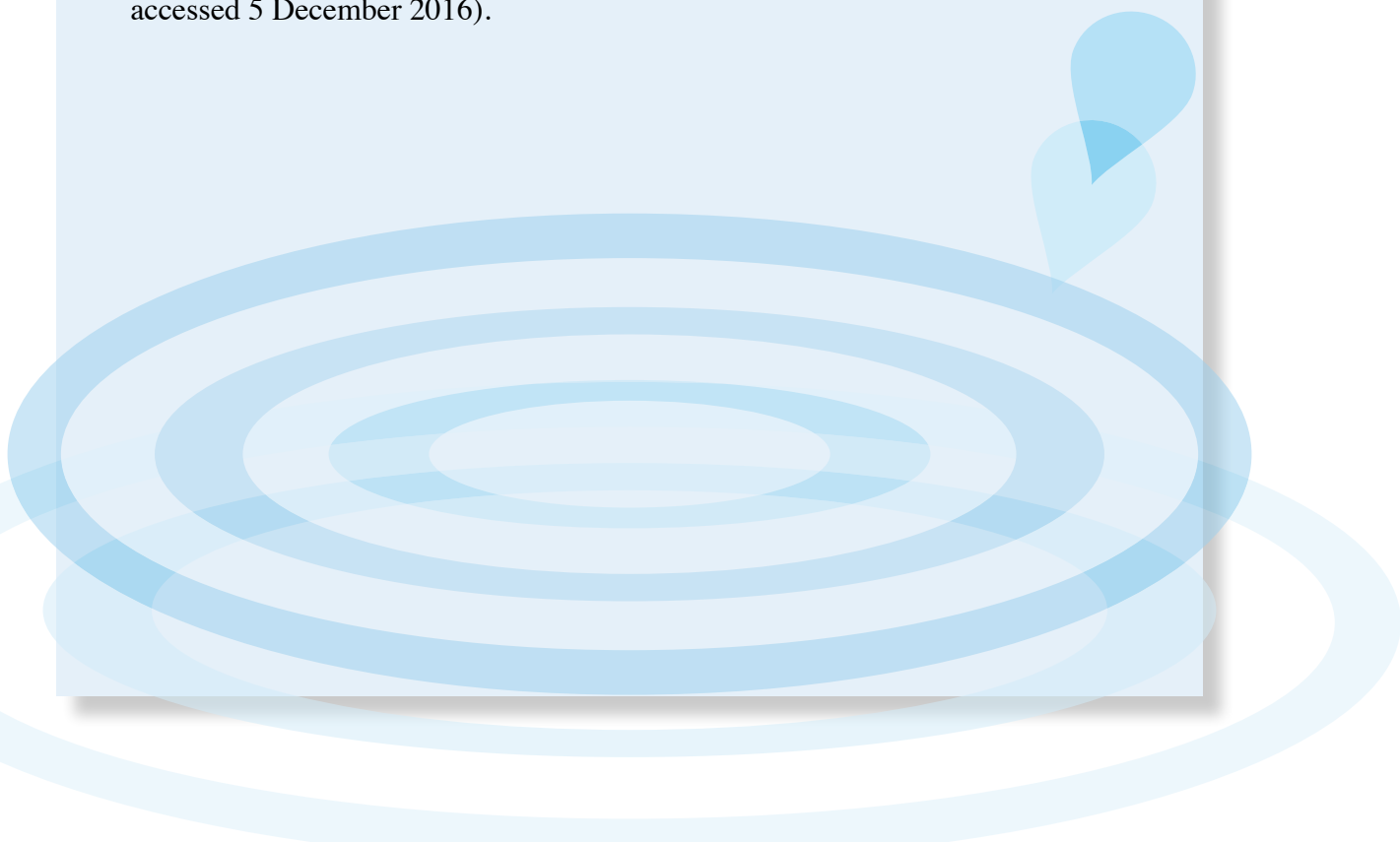
8. Hospital preparedness planning

During floods, normal activities in hospitals and other health care services can be disrupted by damage to infrastructure (e.g. power and water supply interruptions, damage to vital equipment, disruption of internal and external communication systems, blocked transport systems and flooded ambulance stations). Facilities may also experience an increased influx of patients, including patients who require particular specialized care. Flooding may require health care services to expand beyond their normal capacity to meet community demand. Hospitals should therefore ensure that they have:

- well functioning command and control system;
- strategies for clear, accurate and timely communication;
- well developed safety and security procedures;
- mass-casualty triage protocol;
- surge capacity – defined as the ability of a health service to expand beyond normal capacity to meet increased demand for clinical care;
- availability of essential services that can continue in parallel with the activation of a hospital emergency response plan;
- systems for effective human resource management;
- plan to ensure continuity of the hospital supply and delivery chain;
- post-disaster recovery planning procedures.

Source

WHO Regional Office for Europe (2011). Hospital emergency response checklist: an all-hazards tool for hospital administrators and emergency managers. Copenhagen (http://www.euro.who.int/__data/assets/pdf_file/0020/148214/e95978.pdf?ua=1, accessed 5 December 2016).



9. Contingency plans for health facilities

Organization of work

- Rapidly establish headquarters and space for administration.
- Have baseline knowledge of local population's health, as this can affect the services and level of care that may be required.
- Ensure access to primary care to prevent exacerbation of chronic conditions, reducing the likelihood of premature death and unnecessary hospitalization.
- Maintain communication between ministry of health and nongovernmental organizations.
- Ensure that staff members can work by making provision for child care.
- Ensure that staff bring their own food supplies.
- Reassign nurses from nonessential positions (e.g. routine outpatient care).
- Use point-of-care tests and analysers when generators fail.
- Ensure that water for hand washing is available, use alcohol-based hand sanitizers when the water supply or electricity is disrupted.

Patient care

- Ensure that patient records can be shared among health facilities.
- Create fast-track triage for patients with minor injuries or non-acute medical complaints.
- Plan possible displacement of patients.
- Prepare medical algorithms for discharging patients who can go home.
- Write succinct patient notes by hand and tape them to patients' chests if communication systems are disrupted.
- Prepare for changes in outpatient populations if the flooding has caused population displacement.
- Prepare lists of patients in different health districts who might be affected.

Supply management

- Place large orders for hospital pharmacies, if there is time.
- Hold stocks of supplies in several places or outside the risk area.
- Bring forward or postpone elective surgical procedures.
- Give patients supplies of medication.
- Give patients telephone numbers of other health facilities.
- Obtain complete contact details of patients and close relatives.
- Anticipate need for temporary morgues, as hospital morgues may fill up sooner than expected.
- Ensure that existing decontamination areas are operational or set up a new area.

Water, sanitation and food supply management

- Identify alternative water sources and ensure adequate water supply.
- Ensure proper sanitation and hygiene supply.
- Ensure food supply.

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10. Planning for emergency shelters

Most people who lose their homes will be able to find places to stay with friends or family. The need to find other sources of shelter only emerges when housing losses reach more than around 25%. The minimum recommended floor space in emergency shelters is approximately 5 m² per person.

Suggested medical capabilities in a shelter include:

- initial assessment of health care needs by a physician;
- determination of ongoing prescription needs;
- identification and coordination of special health care requirements;
- arrangements for post disaster follow-up care, logged on a database wherever possible.

Communication with multiple community health care providers is key to successful arrival, care through stay, and return home.

A medical hotline can be set up and times established for conference calls to coordinate hospital transfers, arrange ongoing health needs and communicate with pharmacies, community care and health partners.

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11. Chemical hazard management during and after flood events

Chemical spills resulting from floods can cause acute and long-term risks for, and effects in, humans. Floods and other disasters often cause hazardous chemicals (fuel; corrosive, industrial and agricultural chemicals) to spill out of vehicles, industrial facilities, fuel or chemical storage places and other sources. They may also bury or move chemicals and chemical containers. These can pose health hazards to the general public, emergency service personnel and clean-up workers.

During a flood

The main chemical health hazards during a flood include:

- injuries from chemical explosions;
- burning or blistering and severe damage to skin, eyes or respiratory tract from release of corrosive chemicals;
- intoxication and acute poisoning, mostly from inhalation of evaporated highly toxic chemicals such as fuel compounds, solvents, burning products.

Measures to prevent transmission of communicable diseases are also effective for prevention of exposure to chemicals during a flood.

Health care and public health professionals should undertake a number of specific activities.

- Ensure decontamination of people who have been in contact with hazardous chemicals.
- Provide health care services to all affected people, taking account of the possibility of acute poisoning by hazardous chemicals, and bearing in mind that the most vulnerable population groups for chemical hazards are children, elderly people, hospital patients and rescue workers, who may be exposed to high levels of chemicals (NB: greater attention should be paid during the acute phase of a disaster).
- Register all cases of contact with hazardous chemicals and acute poisoning to ensure long-term assessment and prevention of effects – sampling and storage of biological samples is recommended for future analysis and assessment.
- Conduct a rapid risk assessment of the event and assist in identification of places where hazardous chemicals are stored to facilitate implementation of measures to prevent releases and spills;
- Communicate information about chemical hazards to the public.

After a flood: cleaning up

The sheer volume of water during a flood may dilute chemical spills but chemical pollution can still be high in certain areas and precautions should be taken when cleaning up after flooding.

Clean-up workers and people returning to their houses after a flood should be made aware of chemical hazards and provided with clear instructions to protect them from chemical exposure, including exposure to chemical waste.

Several core characteristics of chemical contamination after a flood should be kept in mind for effective protection of the population.

- Chemical concentration is usually higher in places where chemicals are stored or used (e.g. industrial facilities, garages, cellars, farms) so these should be ventilated before entering.
- Some signs of possible chemical contamination are usually present (e.g. discoloured water, smell/odour, oil films, empty or damaged containers) but many hazardous chemicals are colourless and odourless. The presence of damaged, unlabelled chemical containers can be an indicator of potential chemical pollution.
- Chemical waste should be collected separately and disposed of in specially designated places.
- Permission to return home should be given only after all possible sources of chemical spills are eliminated and there are no visible signs of chemical contamination.
- Floods often result in the need for emergency renovations to damaged homes and other structures. Where these contain lead-based paint and asbestos, common renovation activities (e.g. sanding, cutting, demolition) can increase exposure to such hazards.

Recovery stage

Measures taken during the recovery stage are designed to prevent indirect chemical effects and long-term exposure. Priority should be given to areas in which contamination would have significant effects, such as farmland (prevention of chemical contamination of food); water bodies used for water supplies and leisure activities; kindergarten and school yards and other areas for children.

1. Public health can play an important role in four of the many activities that need to be undertaken in the recovery phase.
2. Organization of health care and provision of access to information and assistance.
3. Risk and health outcome assessment, including exposure and environmental and human health assessments.
4. Implementation of remediation and restoration activities.
5. Evaluation, including root cause analysis, response and lessons learnt.

Practical considerations must govern the measures undertaken.

- For each site and substance, a vulnerable zone (the area in which the contaminants might pose risks for human health) should be estimated and mapped out, based on environmental monitoring – it is important to identify the spectrum of toxic chemicals present whenever possible.
- Appropriate health surveillance systems should be in place – virtually every organ system can be damaged by chemical exposure, with the degree of harm related to the chemical hazard, amount and route of exposure.

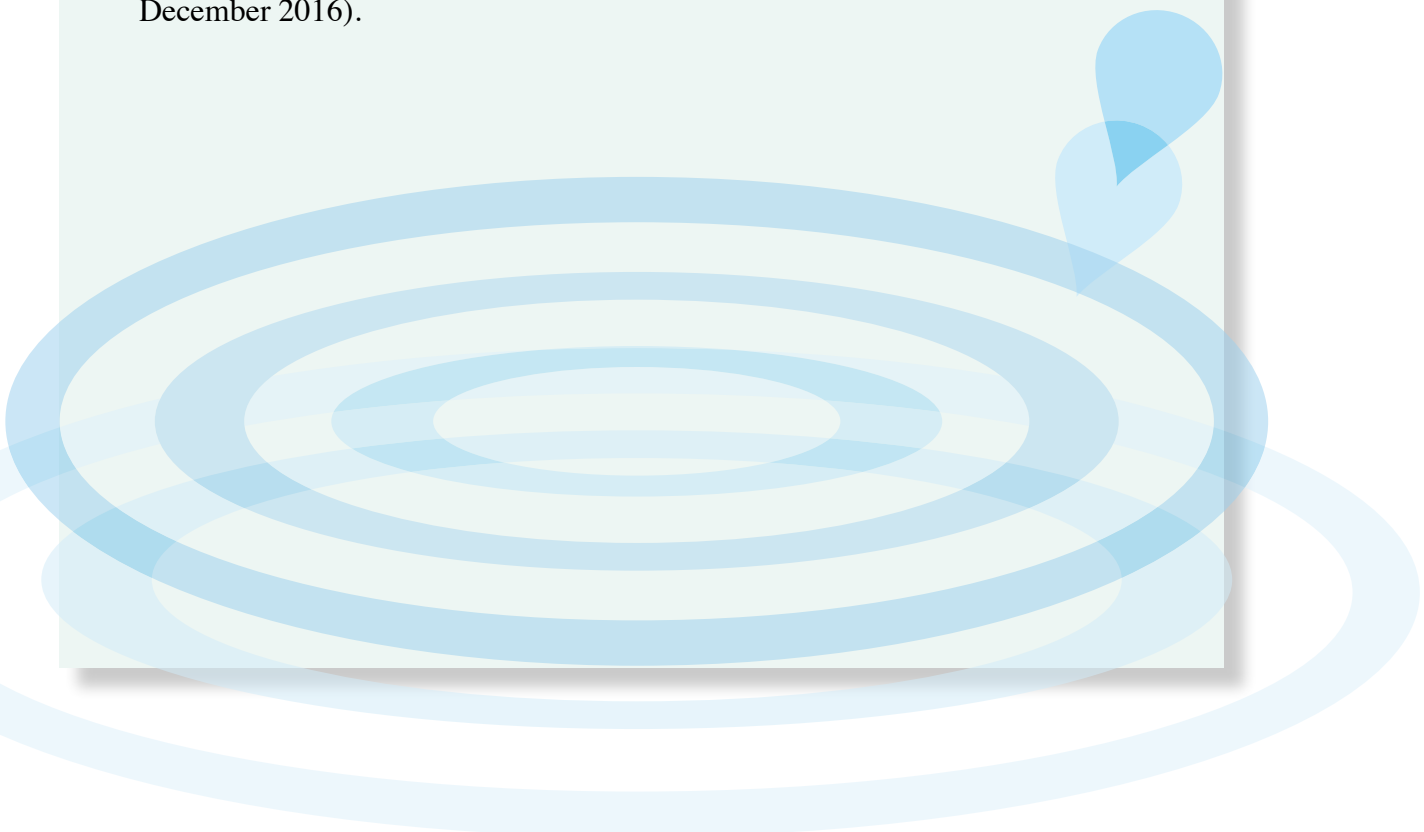
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12. Disease surveillance during and after flood events

During and after a flood event:

- assess the needs of the affected population;
- match available resources to those needs;
- prevent exacerbation of adverse effects;
- protect population from further health effects by implementing disease control strategies where appropriate and well defined;
- monitor and evaluate the effectiveness of emergency health plans and activities;
- use experience gained to improve contingency planning.

Some important health outcomes to consider when assessing flood risk are shown in Table 2.

Table 2. Important health outcomes to consider when assessing flood impacts

Health effect	Examples	The burden
Mortality	<ul style="list-style-type: none"> – drowning, injuries, hypothermia – death from myocardial infarction or stroke 	– direct mortality from the flood (e.g. drowning); indirect mortality from all causes in the region affected by flooding for approximately one year
Infectious disease	<ul style="list-style-type: none"> – disease linked to poor water quality, sanitation and food safety (e.g. cholera) – rodent-borne disease (e.g. leptospirosis) – vector-borne disease – disease associated with overcrowding 	– local and regional disease patterns will determine the exact types of illnesses for surveillance. WHO guidance recommends that measles and acute neurological diseases are monitored during a flood event, and nutritional stress. TB, HIV/AIDS, sexually transmitted infections (STIs), sexual and non-sexual assault, neonatal tetanus, infant and maternal mortality should be monitored after flooding (WHO, 2012). Additionally, Public Health England and the Centers for Disease Control and Prevention recommend monitoring of new, emerging or unusual illnesses in the flood-affected area (PHE, 2014; CDC, 2010)
Injuries	<ul style="list-style-type: none"> – drowning, electrocution, trauma, road traffic injuries, sprains or strains, lacerations, poisoning from use of generators, exposure to chemicals, animal bites or stings 	

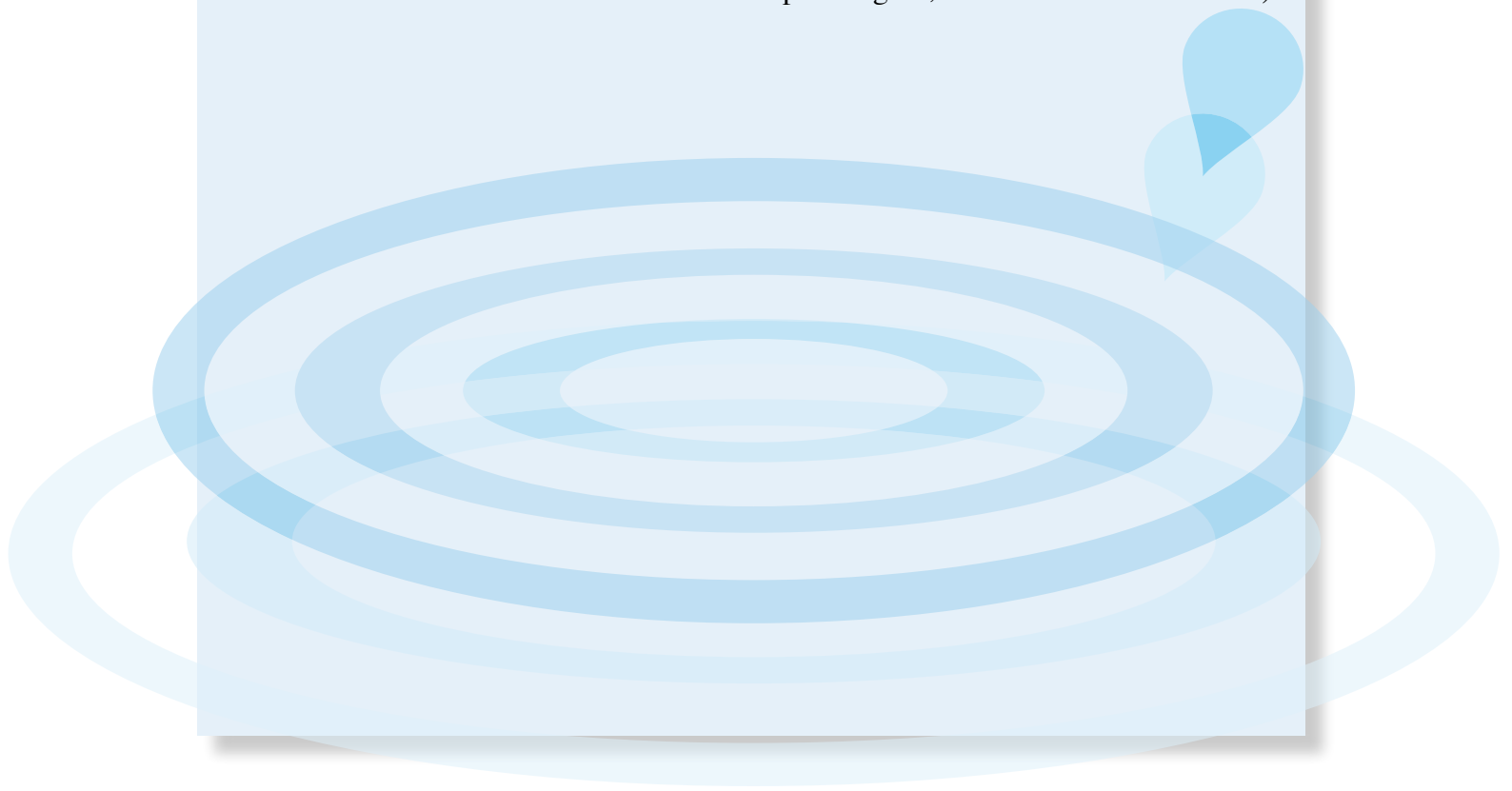


Table 2 contd.

Health effect	Examples	The burden
Mental health	– anxiety, depression, post-traumatic stress disorder, acute neurological diseases	– both common mental disorders and post-traumatic stress disorders are likely to increase in the immediate term and for months to years after a flood event. Other mental illnesses may become worse after a flood event
Other noncommunicable diseases	– diabetes, acute renal failure (e.g. related to lack of continuation of treatment or lack of access to health care), effects of long-term exposure to chemicals	
Other diseases and conditions	– including nutritional stress, sexual and non-sexual assault, infant and maternal mortality	

Source

Menne B, Murray V, editors (2013). *Floods in the WHO European Region: health effects and their prevention*. Copenhagen: WHO Regional Office for Europe (<http://www.euro.who.int/floods-in-the-who-european-region>, accessed 5 December 2016).



13. Vaccination during flood events

In an acute emergency such as a flood event, the objective of vaccination is not to ensure the progressive increase of population immunity that would result in long-term protection against a given disease, but rather the rapid reduction of risk from a disease in order to protect a population during a relatively short period of extreme vulnerability.

In no circumstances should an acute emergency be seen as an opportunity for rapid achievement of the goals of a routine vaccination programme. On the contrary, those goals should be set aside in order to use vaccines for one clear and present objective: to limit the number of excess preventable deaths for which the emergency might be responsible.

For these reasons, certain strategies (e.g. mass vaccination campaigns, expanded target age groups, reduced courses for certain vaccines) warrant greater consideration in acute emergencies than they might in other circumstances, whether or not routine vaccination services remain functional.

The SAGE framework covers only that period of time between the onset of emergency and re-establishment of routine vaccination programmes. Any additions to routine vaccination should only be considered for vulnerable population groups under certain specific circumstances.

Rescuers and relief workers

- Hepatitis A and/or B vaccination is recommended for selected high-risk individuals such as public utility workers (e.g. those involved in cleaning operations, sewage, waste or drinking-water management).
- Tetanus toxoid with or without tetanus immunoglobulin, as appropriate, is recommended for those whose vaccinations are not up to date, and should accompany wound treatment.

WHO provides general guidance on the Immunization, vaccines and biologicals website: http://www.who.int/immunization/policy/immunization_tables/en/.

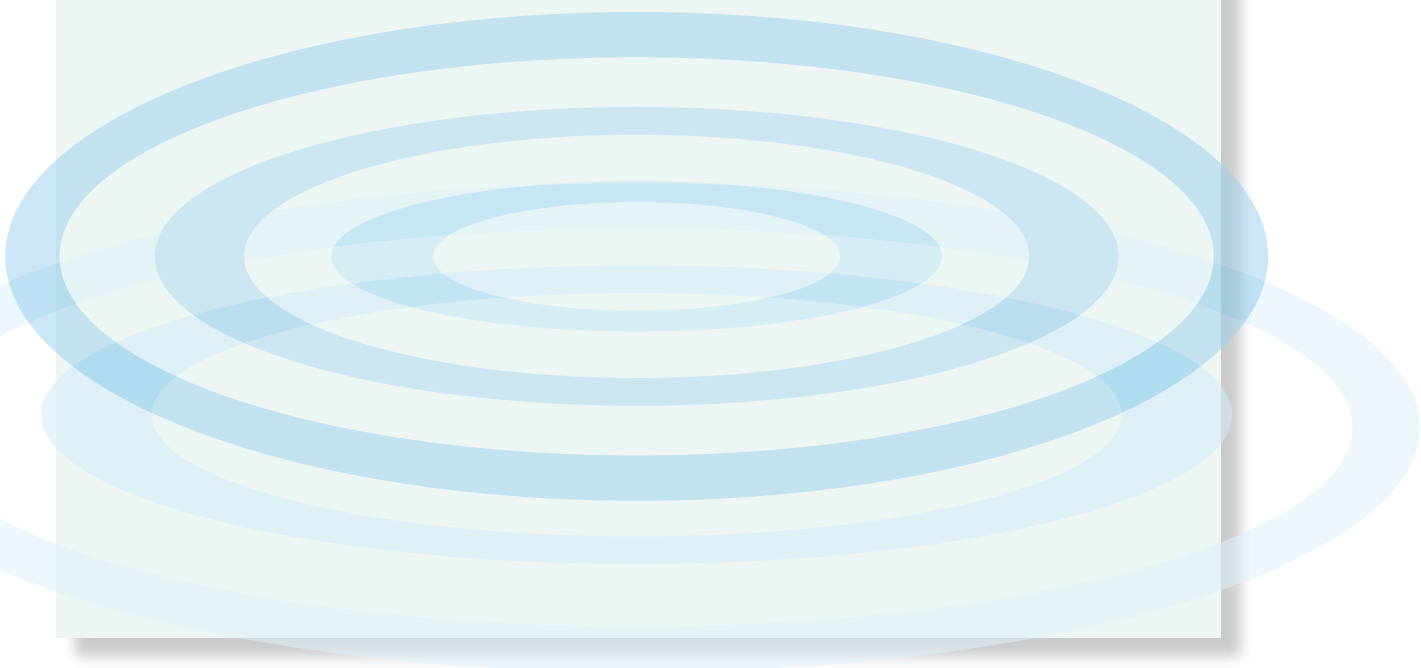
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14. How to deal with dead human bodies

Dead or decayed human bodies originating from natural disasters and accidents do not generally represent a health hazard; the situation presents a health risk only when communicable disease has caused the fatalities. The following tasks should be undertaken when handling dead bodies.

- Protect those handling dead bodies; basic hygiene is essential:
 - use gloves, personal protective clothing and equipment;
 - avoid wiping face or mouth with hands and wash hands with disinfectant soap and water after handling dead bodies;
 - clean and disinfect regularly all equipment, clothes and vehicles used in transportation and storage of dead bodies;
 - ensure availability of first aid and provision of medical services in case of injury, and take necessary measures to prevent exposure to environmental hazards (e.g. vaccination of workers).
- Collect dead bodies as soon as possible but it is neither necessary nor advisable to rush their disposal because the bodies are required for identification purposes.
- Support body identification to reduce the psychological effects on survivors. Bodies should be placed in body bags or, if these are not available, in other suitable locally available materials. Use waterproof labels with unique reference numbers. The publication *Management of dead bodies after disasters* (Morgan, Tidball-Binz and van Alphen, 2006, updated 2009) provides detailed information on procedures for body recovery.
- Identify bodies quickly. Keep personal belongings with bodies not only for identification purposes but also in consideration of legal and psychological implications for survivors. Forensic procedures (autopsies, fingerprints, DNA, dental records) can be used where visual identification of bodies or photographs becomes impossible. On completion of formal identification, bodies should be released to relatives or their communities to follow local custom and practice.
- Ensure temporary storage of dead bodies. In warm climates a body begins to decompose within 12 to 48 hours; bodies should be refrigerated at between 2 °C and 4 °C; where possible, a refrigerated container should be used for transportation of bodies. Temporary burial is an alternative option when electricity or refrigerated storage facilities are lacking, or where no other method is available. Temporary burial sites should be selected taking account of the hydrogeological and cultural conditions of the area, and in consultation with local authorities.
- Organize long-term storage for unidentified bodies. Burial in individual graves is a means for long-term storage. Where a local cemetery is not accessible, burial places should be identified following liaison with the local authority to ensure adequate siting (for example, away from drinking-water sources).

- Provide mental health support. The psychological trauma of losing loved ones and witnessing death on a large scale is the greatest concern. Anyone involved in handling dead bodies should be aware of the stress and trauma of family members, and should provide support to the greatest possible extent.

Sources

Morgan O, Tidball-Binz M, van Alphen D, editors (2006, updated 2009). Management of dead bodies after disasters: a field manual for first responders. Washington DC: Pan American Health Organization (<https://www.icrc.org/eng/assets/files/other/icrc-002-0880.pdf>, accessed 5 December 2016).

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Wisner B, Adams J, editors (2002). Environmental health in emergencies and disasters: a practical guide. Geneva: World Health Organization (http://www.who.int/water_sanitation_health/hygiene/emergencies/emergencies_2002/en/, accessed 5 December 2016).



15. How to deal with dead animals

After an emergency situation, often large numbers of dead animals require timely disposal through either burial or burning. In the case of floods, suitable disposal areas, dry firewood or other material may not be readily available to burn the carcasses. The smell and sight of decomposing bodies can cause distress and also pollute water supplies.

Disposal of animal bodies involves special processes in accordance with their number and size. Generally, it is difficult to dispose of large animals (cattle, horses). A temporary, initial measure is to spray them with oil and cover them with dirt until the necessary conditions for final burial exist. Moreover, it is important not to neglect the surviving animals, which should be brought together, cared for and monitored in order to prevent any outbreak of disease. Necessary steps should be taken to control and eradicate vectors that can carry endemic diseases.

Final disposal requires dead animals to be buried and covered with soil in pits that are 1 m deep at sites where there is no possibility of contaminating surface or ground water. This should be sufficient in most situations, but should be reviewed in the case of flooding when it is more appropriate to bag the corpses until they can be cremated or buried.

The three common methods of animal disposal are described below.

1. Rendering: a process in which a carcass is cooked at high temperatures and converted into animal feed or fertilizer. This is the easiest way to dispose of carcasses, especially those of farm animals.
2. Burning (cremation or incineration): either in the open air or using commercial incinerators.
3. Burial: possible only where local ordinances and the terrain permit. The location selected should be approved in advance by the appropriate government agency; burial may only be permitted at certain locations. Heavy equipment may be necessary to move animals and dig pits.

The method used will depend on the disaster; location of the bodies; type and number of animals killed; and local ordinances. Whatever the method, carcass disposal should be given high priority. If community services are not interrupted, the usual methods for disposal of animals that die naturally can be used. If community services are disrupted, special arrangements may be needed to accommodate other methods.

Humans are at little risk from animal carcasses if proper precautions are taken. For example, those working to clean up areas containing swine or poultry carcasses should wear protective clothing and observe basic hygiene, including:

- practising proper handwashing to prevent infection with certain pathogens that may be transmitted from farm animals, including salmonella and *E. coli*;

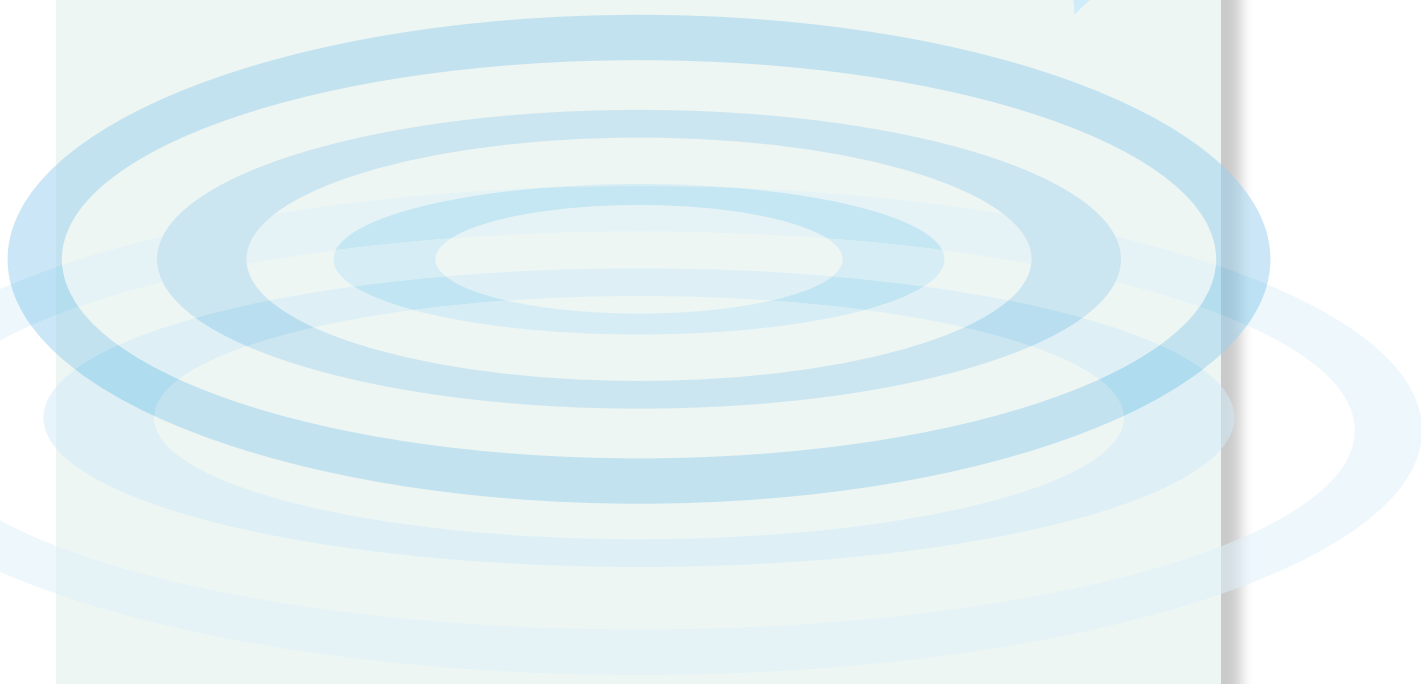
- securing all food sources and remove any animal carcasses to avoid attracting rats; and
- wearing insect repellent when outdoors: emergencies such as natural disasters may lead to more mosquitoes, which can carry disease.

Sources

CDC (2016). Animal disposal following an emergency. In: Natural disasters and severe weather [website]. Atlanta GA: Centers for Disease Control and Prevention (<http://emergency.cdc.gov/disasters/animaldisposal.asp>, accessed 5 December 2016).

FAO Agriculture and Consumer Protection Department (2016). Epidemics and disease flare-ups after disaster situations. In: Animal production and health [website]. Rome: Food and Agriculture Organization of the United Nations (http://www.fao.org/ag/againfo/programmes/en/empres/news_epidemics_080910.html, accessed 5 December 2016).

PAHO (2004). Management of dead bodies in disaster situations. Washington DC: Pan American Health Organization (Disaster Manuals and Guidelines Series, No.5; http://www.who.int/hac/techguidance/management_of_dead_bodies.pdf, accessed 5 December 2016).



16. Venomous snake bites

Snake bites are common during floods, and bites by venomous snakes can have severe consequences. Victims of snake bites may suffer any or all of the following:

- local envenoming, confined to the part of the body that has been bitten – these effects may be debilitating, sometimes permanently;
- systemic envenoming, involving organs and tissues away from the part of the body that has been bitten – these effects may be life-threatening and debilitating, sometimes permanently;
- effects of anxiety prompted by the frightening experience of being bitten and by exaggerated beliefs about the potency and speed of action of snake venoms – these symptoms can be misleading for medical personnel;
- effects of first aid and other pre-hospital treatments that may cause misleading clinical features – these may be debilitating and, rarely, even life-threatening.

Stages in the management of snake bites

Recommended first-aid methods emphasize reassurance; immobilization of the whole patient and, particularly, the bitten limb; and moving the patient to a place where they can receive medical care as soon as possible.

- Apply first aid:
 - reassure the victim, who may be very anxious;
 - lay the patient in a comfortable and safe position to immobilize all of the body and, especially, immobilize the bitten limb with a splint or sling as any movement or muscular contraction increases absorption of venom into the bloodstream and lymphatics;
 - consider pressure immobilization or a pressure pad if the necessary equipment and skills are available, unless an elapid bite can be excluded;
 - avoid any interference with the bite wound (incisions, rubbing, vigorous cleaning, massage or application of herbs or chemicals) as this may introduce infection, increase absorption of the venom and increase local bleeding;
- Transport patient to hospital.
- Undertake rapid clinical assessment and resuscitation.
- Perform detailed clinical assessment and species diagnosis.
- Perform investigations and laboratory tests.
- Administer antivenom treatment.
- Observe response to antivenom.
- Decide whether further dose(s) of antivenom are needed.
- Administer supportive/ancillary treatment.
- Treat the bitten part of the body.

- Begin rehabilitation.
- Treat chronic complications.

Prevention of snake bites involves informing communities about snake-bite risks and prevention techniques, such as:

- avoiding tall grassy areas;
- wearing protective shoes/boots;
- keeping storage areas clear of rodents;
- removing rubbish, woodpiles and low brush from around the home; and
- storing food in rodent-proof containers, raising beds above floor level and tucking mosquito nets securely under sleeping mats within the home.

To prevent or limit the serious health consequences of snake bites, health care providers should be educated on snake-bite management, including the proper use and administration of antivenom. Knowledge of the species of venomous snakes that present the greatest risks to human populations in any particular region or country is essential for addressing snake-bite problems. Antivenoms are the only effective treatment to prevent or reverse most of the venomous effects of snake bites.

WHO has created a database and image library to enable easy identification of the most important venomous snakes in the users' country, territory or area; show the distributions of each species; and find information about antivenom products for treating envenoming caused by their bites.

Sources

Warrell DA (2010). Guidelines for the management of snake-bites. New Delhi: WHO Regional Office for South-East Asia (<http://apps.who.int/medicinedocs/en/d/Js17111e/>, accessed 5 December 2016).

WHO (2013). Animal bites [online]. Geneva: World Health Organization (Fact sheet N°373; <http://www.who.int/mediacentre/factsheets/fs373/en/>, accessed 5 December 2016).

WHO (2015). Snake antivenoms [online]. Geneva: World Health Organization (Fact sheet N° 337; <http://www.who.int/mediacentre/factsheets/fs337/en/>, accessed 5 December 2016).

WHO (2017). Venomous snakes distribution and species risk categories [online database]. Geneva: World Health Organization (<http://apps.who.int/bloodproducts/snake-antivenoms/database/default.htm>, accessed 5 December 2016).



17. Food safety during or after flood events

Food can become contaminated at any point before consumption, including during preparation, if not properly handled, prepared and stored. Food safety is particularly important for infants, pregnant women and elderly people, who are most susceptible to foodborne disease.

Food safety concerns during and after flood events include:

- increased risk of outbreaks of foodborne disease, including diarrhoea, dysentery, hepatitis A and typhoid fever;
- increased likelihood of using contaminated water for food handling and preparation;
- population displacement forcing people to have fewer food choices and use more risky food handling practices;
- contaminated fruit and vegetables;
- lack of safe water, poor sanitation and hygiene;
- impairment of the cold chain and proper heat treatment of foods because of problems with power supplies.

Food safety encompasses actions to ensure that all food is as safe as possible. Food safety policies and actions must cover the entire food supply chain – starting in the environment, and moving through primary production, processing, distribution and preparation to consumption.

Avoid communicable disease outbreaks by advising people to follow the five keys to safer food.

1. Keep hands and utensils clean.
2. Separate raw and cooked food.
3. Cook food thoroughly.
4. Keep food at a safe temperature.
5. Choose to use safe water and raw materials.

Key behaviours surrounding safe food handling, preparation, hygiene and sanitation are the most important measures to protect individuals and families.

Sources

WHO (2006). Five keys to safer food manual. Geneva: World Health Organization (<http://www.who.int/foodsafety/publications/consumer/5keys/en/>, accessed 5 December 2016).

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18. Outbreak surveillance

Ideally, emergency outbreak surveillance should prioritize a maximum of eight to 12 diseases or syndromes (see Table 3), ranked by:

- epidemic potential;
- ability to cause severe morbidity or death;
- international surveillance requirements (International Health Regulations/public health emergency of international concern);
- availability of prevention and control measures;
- availability of reliable and meaningful case definitions and simple laboratory tests, where appropriate.

The WHO publication *Outbreak surveillance and response in humanitarian emergencies* provides detailed advice and recommendations.

Table 3. Infectious diseases that may be encountered during floods in the WHO European Region

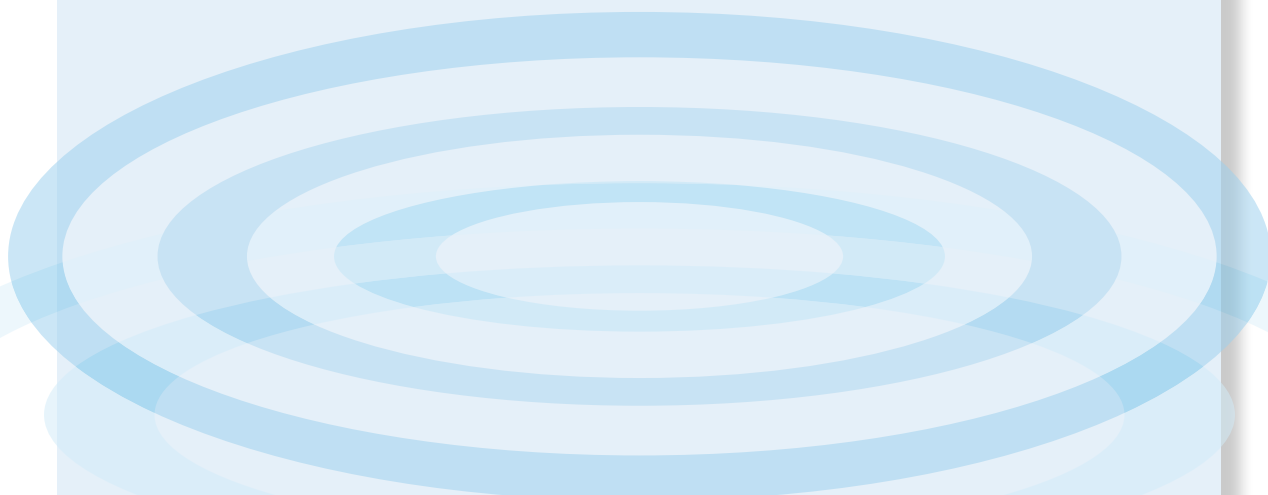
Diseases linked to poor water, sanitation and food safety	Diseases associated with overcrowding	Vector-borne diseases	Rodent-borne diseases	Other
Diarrhoeal diseases ^a	Diarrhoeal diseases ^a	Dengue Chikungunya	Leptospirosis	Tetanus
Acute respiratory infections	Acute respiratory infections Pneumonia	Malaria	Hantavirus	Rabies
	Influenza	West Nile virus	Tularaemia	
Hepatitis A	Hepatitis A	Tahyna virus	Louse-borne typhus	
Hepatitis E	Hepatitis E			
	Meningitis	Other mosquito-borne viruses		
	Tuberculosis			
	Measles			
	Diphtheria			
	Pertussis			
	Scabies and head lice			

^a Diarrhoeal diseases, potentially sensitive to flooding include: (i) bacterial diseases – *Campylobacter* enteritis, cholera, *Escherichia coli* enteritis, paratyphoid, salmonella enteritidis, shigellosis, typhoid, yersiniosis; (ii) viral diseases – rotavirus, norovirus; and (iii) parasitic diseases – amoebic dysentery, ancylostomiasis (hookworm), ascariasis (roundworm), balantidiasis, *Cryptosporidium* enteritis, diphyllbothriasis, giardiasis, strongyloidiasis, trichuriasis (whipworm).

Sources

Brown L, Murray V (2013). Examining the relationship between infectious diseases and flooding in Europe: a systematic literature review and summary of possible public health interventions. *Disaster Health*.1(2):117–27 (<http://tandfonline.com/doi/full/10.4161/dish.25216>, accessed 5 December 2016).

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19. Vector-borne diseases during or after flood events

Vectors such as mosquitoes can transmit infectious diseases. Risk factors include increasing temperatures during or after floods, and residual standing water. Health effects may be observed many weeks after the flood event, so the following actions are recommended.

- Ensure sustainable vector control to prevent transmission. Use a combination of top-down and bottom-up approaches that integrate chemical, mechanical and biological vector-control and personal protection methods, with the active participation of communities and involvement of relevant sectors and agencies.
- Prevent outbreaks. It is advisable to have plans for hospitalization, emergency vector control, advocacy, community mobilization, logistics and monitoring and evaluation in the case of increased risk or presence of vector-borne diseases.
- Strengthen disease diagnosis and case management. Both early recognition of disease and thorough knowledge of the anticipated clinical manifestation in successive phases of disease are the basis for effective case management. Prompt notification of infections and their locations must be communicated to the emergency response unit to facilitate detection and management of outbreaks.

Sources

ECDC (2012). Guidelines for the surveillance of invasive mosquitoes in Europe. Stockholm: European Centre for Disease Prevention and Control (<http://www.ecdc.europa.eu/en/healthtopics/vectors/mosquito-guidelines/Pages/mosquito-guidelines.aspx>, accessed 5 December 2016).

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20. Rodent-borne diseases

There is some concern about diseases transmitted by rodents, which could increase during or after heavy rainfall and flooding as a result of altered patterns of contact. Leptospirosis is an example of such diseases.

The following advice should be given to people during floods and when returning home.

- Keep food in sealed cupboards and/or containers out of the reach of rodents.
- Do not leave pet food out in the open.
- Keep waste sealed in rubbish bins.
- Ensure that all entrances and windows are suitably sealed to prevent entry of rodents.

Most importantly, during periods of flooding, people should be encouraged to seek professional medical help if they fall ill. Also, it is very important to control commensal rodents prior to any event.

Source

Bonnefoy X, Kampen H, Sweeney K (2008). Public health significance of urban pests. Copenhagen: WHO Regional Office for Europe (<http://www.euro.who.int/en/publications/abstracts/public-health-significance-of-urban-pests>, accessed 5 December 2016).



21. Prevention of West Nile virus outbreaks

Sustained West Nile virus (WNV) activity has been observed in many countries of the European Region in recent years. Flooding events can contribute to increased breeding of the *Culex* mosquito transmitting WNV, resulting in an earlier or stronger WNV season (in areas where the mosquito is present).

In order to prevent and/or reduce the impact of WNV circulation, WHO Regional Office for Europe recommends that health authorities take certain measures.¹

1. Strengthen intersectoral, inter-level and international coordination by:
 - establishing an inter-sector emergency prevention and response team to enhance collaboration and coordination with and within different sectors – the mechanism will entail timely exchange of information and regular meetings;
 - developing a WNV preparedness and response plan, including integrated human and animal health aspects;
 - allocating resources to enable emergency response (i.e. vector control and communications);
 - coordinating with all involved authorities through an emergency unit in case a large area is involved;
 - ensuring cross-border coordination if WNV-related cases occur close to borders;
 - establishing laboratory diagnostic capacity and referral systems in countries.
2. Provide health professionals and health care workers with:
 - information on WNV and guidance on West Nile fever (WNF) detection and treatment;
 - guidance on testing patients returning from affected areas when presenting clinical symptoms or acting as blood/organ donors;
 - national guidelines for clinical management of suspected and confirmed human cases;
 - training on communications about measures to reduce individual risk of exposure to people travelling to, or returning from, affected areas.
3. Communicate WNV risks to the public by:
 - announcing WNF cases early to the community, jointly with relevant sectors;

¹ At the request of Bosnia and Herzegovina, Croatia and Serbia, on 26 May 2014 the WHO Regional Office for Europe organized a conference call including representatives of the three countries, WHO and ECDC. The aim was to discuss measures to prevent vector-borne disease outbreaks following flooding in the Balkans. The main risk identified was a potential WNV outbreak.

- recommending protective measures against mosquito bites before and during the mosquito season (i.e. using personal insect repellent, wearing long-sleeved shirts and trousers, and avoiding outdoor activity at peak biting times);
- informing about clinical symptoms so that sick people can recognize them and seek medical support;
- ensuring maximum outreach of at-risk groups.

4. Control and manage vectors by:

- monitoring the geographical distribution of WNV in human and animal populations, identifying areas at risk of WNV transmission;
- implementing larval control as part of integrated vector control;
- intensifying ground adult mosquito control in areas at high risk for human exposure when WNV circulation is increasing;
- monitoring the efficacy of spraying and use of larvicides on target mosquito populations as well as mosquito density;
- reducing standing water where feasible, or applying larvicide to standing water to prevent breeding and reduce sources of mosquito production in active transmission spots.

Blood safety

People infected with WNV may, on a small scale, transmit the virus through blood transfusion, tissue and organ donations. The virus circulates in the blood one to three days after infection and can last up to 11 days. Blood or organs may be donated prior to onset of symptoms or, in some cases, when an infected person remains asymptomatic. Blood and organ donation restrictions and laboratory testing should be considered in areas affected by a WNV outbreak.

At EU level, EU Blood Commission Directive 2004/33/EC regulates blood safety for WNV. The following recommendations are aimed at mitigating and decreasing the risk of exposure through blood transfusion and organ donation:

- deferral – temporary deferral of 28 days for blood donors, commencing on the day of departure from an area with ongoing WNV transmission to humans;
- post-donation surveillance – requesting donors to report any febrile illness occurring up to 15 days post donation;
- screening of blood donations – use of nucleic acid testing (NAT);
- pathogen inactivation/reduction procedures – currently available for fresh frozen plasma and platelet blood components.

Insecticides

The WHO Pesticide Evaluation Scheme (WHOPES) coordinates the testing and evaluation of pesticides for public health. It recommends the following products as safe to use:

- Adulcicides for aerial spraying http://www.who.int/whopes/Insecticides_for_space_spraying_Jul_2012.pdf?ua=1
- Culex mosquito larvicides: Bti, temephos and spinosad for aerial application http://www.who.int/whopes/Mosquito_Larvicides_25_Oct_2013.pdf?ua=1

Sources

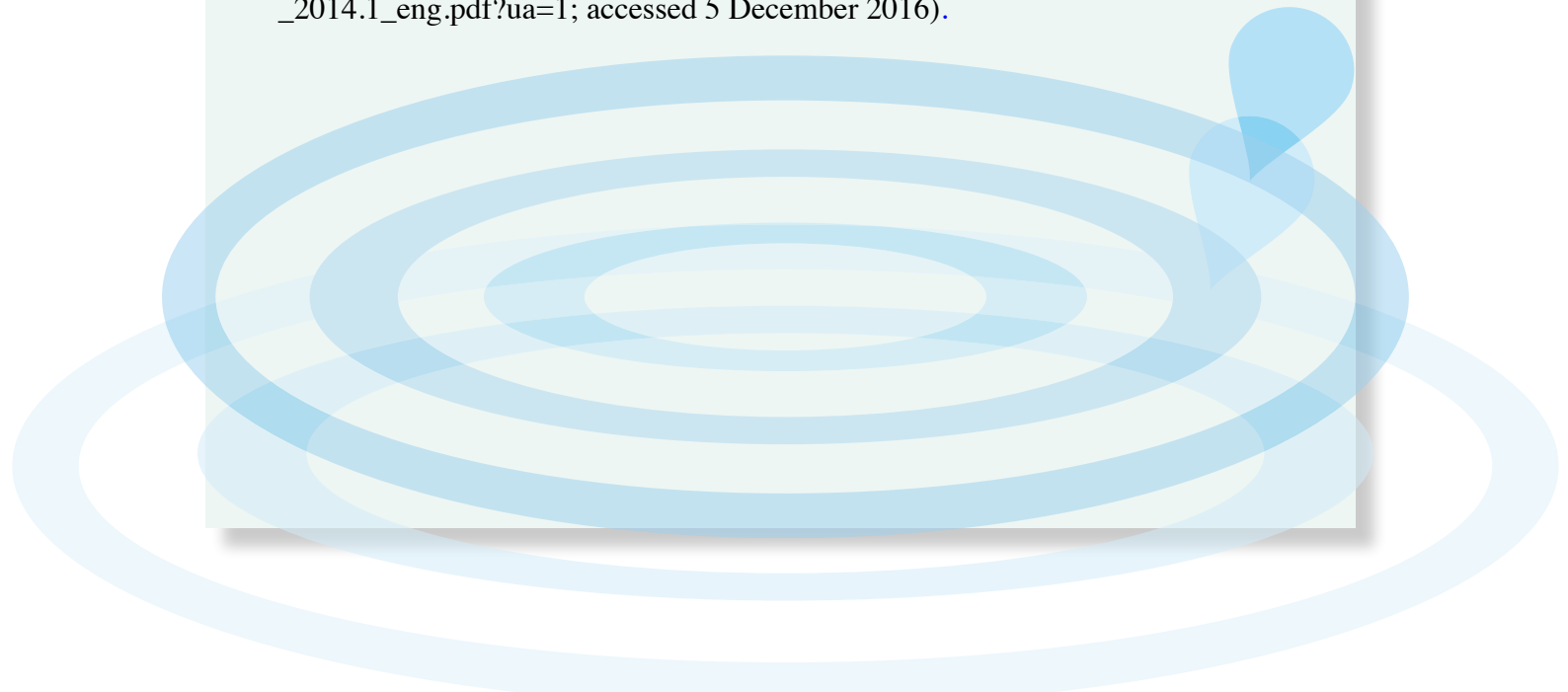
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European Commission (2012). West Nile Virus and blood safety: introduction to a preparedness plan in Europe. Brussels (http://ec.europa.eu/health/bloodtissues_organs/docs/wnv_preparedness_plan_2012.pdf, accessed 5 December 2016).

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22. Mental health and floods

Floods can have a strong effect on mental health. Mental distress is the most common issue but this is usually temporary: most people overcome it by themselves in a reasonable time. Generally, post-flooding psychological assistance should be provided by psychologists and/or other trained personnel. Several specific issues should be kept in mind.

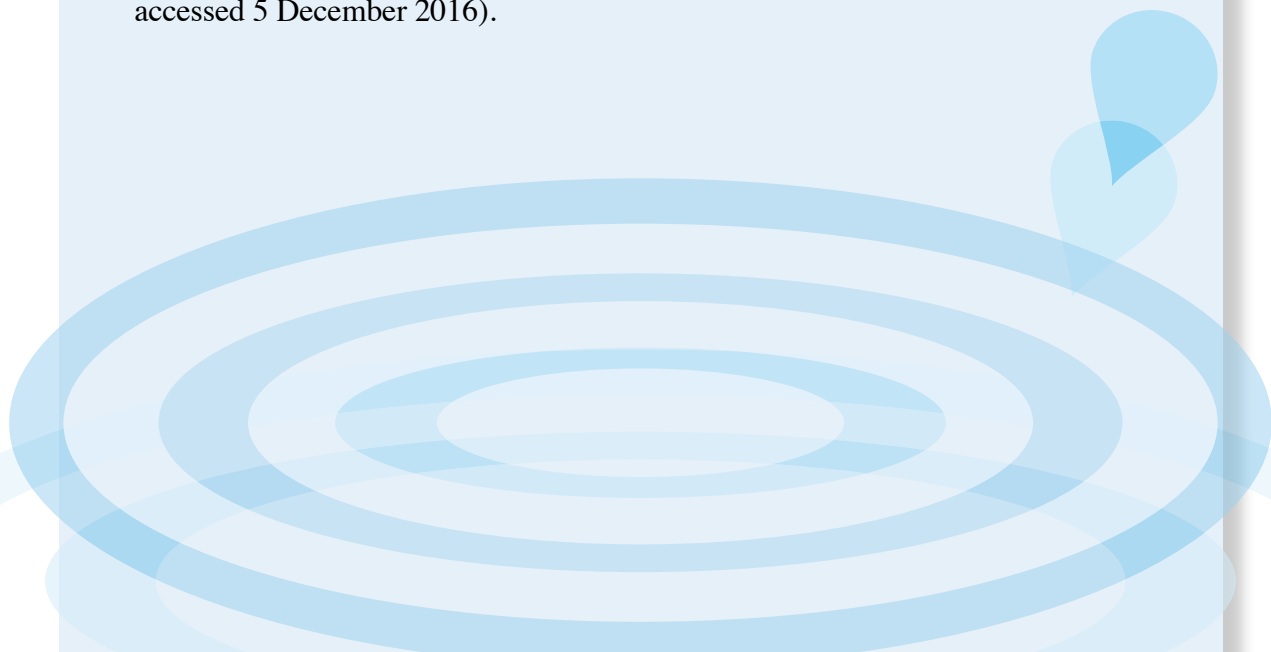
- Encourage people to seek assistance if psychological symptoms aggravate or persist.
- Protect mental health of responders and health care personnel (through appropriate course determined by field psychologists).
- If considered necessary, train field workers in psychological first aid (not administered by professionals).
- Long-term mental health issues (e.g. depression, post-traumatic stress disorder) should be monitored in communities affected.
- Prompt restoration of communities and social cohesion is important in the context of prevention of long-term mental health outcomes of disasters.

Sources

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WHO (2011). Psychological first aid: guide for field workers. Geneva: World Health Organization (http://whqlibdoc.who.int/publications/2011/9789241548205_eng.pdf, accessed 5 December 2016).

WHO (2014). Flooding and communicable diseases fact sheet. Geneva: World Health Organization (http://www.who.int/hac/techguidance/ems/flood_cds/en/index.html, accessed 5 December 2016).



23. Injuries and floods

Injuries occur as people walk and drive through floodwater to rescue their families and pets, or try to protect or recover valued possessions; so-called flood tourism has also been reported. Contact with floodwater is identified as a risk factor for diarrhoea, hypothermia (from standing in water at less than 20 °C) and injuries such as strains, lacerations, fractures and punctures.

Injuries can be a direct result of floating debris, from material such as chemical drums or from unseen hazards concealed by debris. Water conducts electricity, so power lines and electrical appliances pose a risk of electrocution when they are wet or in contact with water. Standing water can force insects such as wasps out of their ground nests and increase the risk for hymenopteran stings. Injuries may also be caused by increasing potential contacts between people and reptiles and other animals displaced by floodwater. People's behaviour and decisions can influence the likelihood of injury and even fatalities, particularly when they do not comply with evacuation orders.

Injuries remain a concern for those involved in clean-up and for children living and playing in areas with debris. Normally there is a high risk of infection to wounds, including tetanus and hepatitis A. Proper wound care should be encouraged and included in public awareness messages. Workers may wish to review their immunization status and risk of exposure specific to their job with a medical provider.

Sources

Menne B, Murray V, editors (2013). *Floods in the WHO European Region: health effects and their prevention*. Copenhagen, WHO Regional Office for Europe (<http://www.euro.who.int/floods-in-the-who-european-region>, accessed 5 December 2016).



24. Water and hygiene in health care facilities during and after flood events

Needs assessment

- Consult with local authorities on whether tap water is safe to use. Agree procedures to receive warnings and access emergency water supply if tap water becomes unfit for human consumption.
- With help from the relevant authority, establish mechanisms to monitor water quality at the health care facility.
- Where tap water is unsafe, assess needs using the following recommended minimum quantities of water per person in each setting type:
 - outpatients: 5 litres/consultation
 - inpatients: 40–60 litres/patient/day
 - operating theatre or maternity unit: 100 litres/intervention
 - VHF isolation centre 300–400 litres/patient/day.

Emergency water supply

- Consult with local authorities to organize emergency water supply and technical options for sources, treatment, disinfection, storage and distribution of water. Emergency water supplies can consist of packaged water, tanker water, direct use of alternative water sources or on-site production of drinking-water.
- If circumstances allow, separate emergency water supplies are encouraged for health-care facilities and the general public.
- Prevent unauthorized people from accessing emergency water supply and storage system.

Water storage

During an emergency, health care facilities may experience intermittent supply of water, thereby creating the need for water storage. There may also be a need to store water after emergency treatment. In such situations:

- containers for transportation and storage of drinking-water should be cleaned and, preferably, disinfected before use;
- water should be stored safely in covered containers in order to prevent (re-) contamination or present a breeding place for insects.

Water quality

During an emergency, water quality may be compromised and emergency treatment may not achieve the usual quality levels. In such situations, microbial drinking-water quality is the first concern.

Water of insufficient or uncertain microbial quality must be boiled if it is intended for drinking, food preparation, brushing teeth or cleaning wounds. Water can be made safe by bringing it to a rolling boil (for example, in an electric kettle or pot on a cooker).

After boiling, the water should be allowed to cool naturally without the addition of ice.

- If water cannot be boiled for all patients, prioritize access to boiled drinking-water for formula-fed infants, immunocompromised and other vulnerable patients.
- If it is not possible to boil water, chemical disinfection of clear, non-turbid water is effective for killing bacteria and most viruses, but not protozoa such as *Cryptosporidium*. Options for chemical disinfection include chlorine compounds or iodine (see Table 4).
- Women should be encouraged to breastfeed their babies, especially when water in the health care setting is of uncertain or insufficient quality.
- Ensure that water below drinking-water quality is clearly labelled and used only for cleaning, laundry and sanitation. Such water should be used for cleaning and laundry only in combination with detergent.

Table 4. Drinking-water disinfection methods in emergencies

Method	Recommendations
Boiling	<ul style="list-style-type: none"> - Bring water to a rolling boil: water is observed to be boiling vigorously and clearly forming lots of bubbles. Remove water from heat and allow to cool naturally. Cool and store all boiled water in clean and covered containers.
Chlorine compounds: <ol style="list-style-type: none"> 1. unscented household bleach (sodium hypochlorite) 2. sodium dichloroisocyanurate (NaDCC) tablet 3. calcium hypochlorite 	<ul style="list-style-type: none"> - For typical room temperature and water temperature of 25 °C, minimum contact time should be 30 minutes; increase contact time for colder water (e.g. double time for each 10 °C less than 25 °C). - Prepare according to package instructions. - Most effective when added to clear water or after settling or clarification. - Type and typical dosage: <ul style="list-style-type: none"> - household bleach (5%): 4 drops per litre - NaDCC: 1 tablet (per package directions) - calcium hypochlorite (1% stock solution): 4 drops per litre.
Iodine compounds: <ol style="list-style-type: none"> 1. tincture of iodine 2. iodine 3. iodine tablet 4. iodinated (triiodide or pentaiodide) resin <p>Caution: not recommended for pregnant women, people with thyroid problems or for use over more than a few months. Excess iodine may be removed after iodine treatment through use of a carbon filter or other effective process.</p>	<ul style="list-style-type: none"> - For typical room temperature and water temperature of 25 °C, minimum contact time should be 30 minutes; increase contact time for colder water (e.g. double time for each 10 °C less than 25 °C). - Prepare according to package instructions. - Type and typical dosage: <ul style="list-style-type: none"> - tincture of iodine (2% solution): 5 drops per litre - iodine (10% solution): 8 drops per litre - iodine tablet: 1 or 2 tablets per litre - iodinated (triiodide or pentaiodide) resin: room temperature according to directions and stay within rated capacity.

Source: WHO (2011).

Ensuring hygiene in health care facilities with limited or no water

Hands are the main pathways of germ transmission during health care. Hand hygiene is therefore the most important measure to avoid transmission of harmful germs and prevent health care associated infections, especially in emergency situations.

- Hands that are not visibly soiled should be cleaned by rubbing with an alcohol-based formulation, the preferred means for rapid, repeated decontamination of hands. Hands that are visibly dirty or soiled should be washed with soap and water for 40 to 60 seconds.
- Hand-rub dispensers can be installed at convenient points and can also be carried by staff as they move between patients.
- Where piped water-supply systems are dysfunctional or unsafe for use, a basin, soap and jug of water can be placed on trolleys to encourage hand washing by patients and staff. Similarly, such a trolley can be used on ward rounds to encourage hand washing by staff as often as needed and between patient contacts.

Wet mopping is recommended for routine floor cleaning. Water for cleaning does not need to be of drinking-water quality, but it should be hot and must be used with detergent. A 0.2% chlorine solution or other suitable disinfectant in cold water can be used if hot water is not available. Routine cleaning procedures should also be applied in emergencies.

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25. Sanitation and hygiene in health care facilities during and after flood events

Needs assessment (toilets)

- For non-emergency circumstances, WHO recommends one toilet per 20 users for inpatient settings (including patients who use bedpans instead of toilets) and at least four toilets for small outpatient settings (one for staff and patients, one for females, one for males and one for children). The number should be increased for larger outpatient settings.

Needs assessment (waste handling and disposal)

- In the absence of functioning sewers and routine waste collection/treatment services, collection mechanisms for both human and medical waste will experience additional strain. Staff involved with handling communal waste from emergency sanitation must be provided with personal protective equipment. For staff handling medical waste, personal protective equipment includes aprons, masks, boots and gloves.
- Waste collection zones need to be protected to prevent access by the general public and disease vectors, and dispersal of hazardous materials by floods and storms. Local authorities can advise on siting of additional disposal areas for human waste (e.g. deep trench latrines for emptying bucket latrines). Facilities for hand washing or hand disinfection should be available in the waste collection zones.

Toilets and hygiene

- Remind patients and staff of the importance of hand washing with soap after every toilet use. If hand-washing facilities have become dysfunctional, provide temporary alternatives (e.g. basin, soap and jug of water and/or hand rub). In an emergency situation, it is particularly important to clean toilets regularly, preferably with detergent and/or disinfectant. Provide gloves for cleaners.
- Prevent toilets from becoming breeding places for disease-transmitting organisms (e.g. mosquitoes, flies, rats) by removing puddles or other habitats for mosquitoes and animals.
- Provide emergency lighting to ensure safe use of toilets during power outages.

Dysfunctional or insufficient numbers of toilets

Where toilets in health care facilities are dysfunctional or insufficient in number, open defecation in the surroundings of hospitals and health care centres must be avoided. The following preventive measures can be taken.

Urban settings

- Sewers or water pipes broken or unusable, toilet bowls still functional. Cover toilet bowls with sealable plastic bags. Add disinfectant or garden soil after each use to decrease infectivity and odour. Store full bags in tight containers until a waste collection system has been re-established.

- Toilet bowls unusable. Provide chemical toilets if financially and logistically viable (including transport and regular emptying/replacement). Camping or bucket toilets are the least preferred option but can be encouraged to prevent open defecation.

Rural settings

- Construct (additional) latrines within health care facility surroundings, but at least 30 metres away from any water source and 10 metres away from any water storage tank or treatment facility. If latrines cannot be built, defecation fields provide an alternative.
- Guidance on construction and considerations for choosing appropriate sanitation technologies is available from WHO – see, for example, *Environmental health in emergencies and disasters* (Wisner and Adams, 2002:pp 131–9).
- Where there are too few functional indoor toilets and additional sanitation facilities are provided outside the health care facility, patients with restricted mobility (including pregnant women, people with physical disabilities and elderly people) should be given priority access to the functioning indoor toilets.
- Where additional or alternative sanitation facilities are built or used, the same considerations regarding functioning toilets for patients with restricted mobility apply.

Safe management of health care waste in the absence of routine collection and treatment services

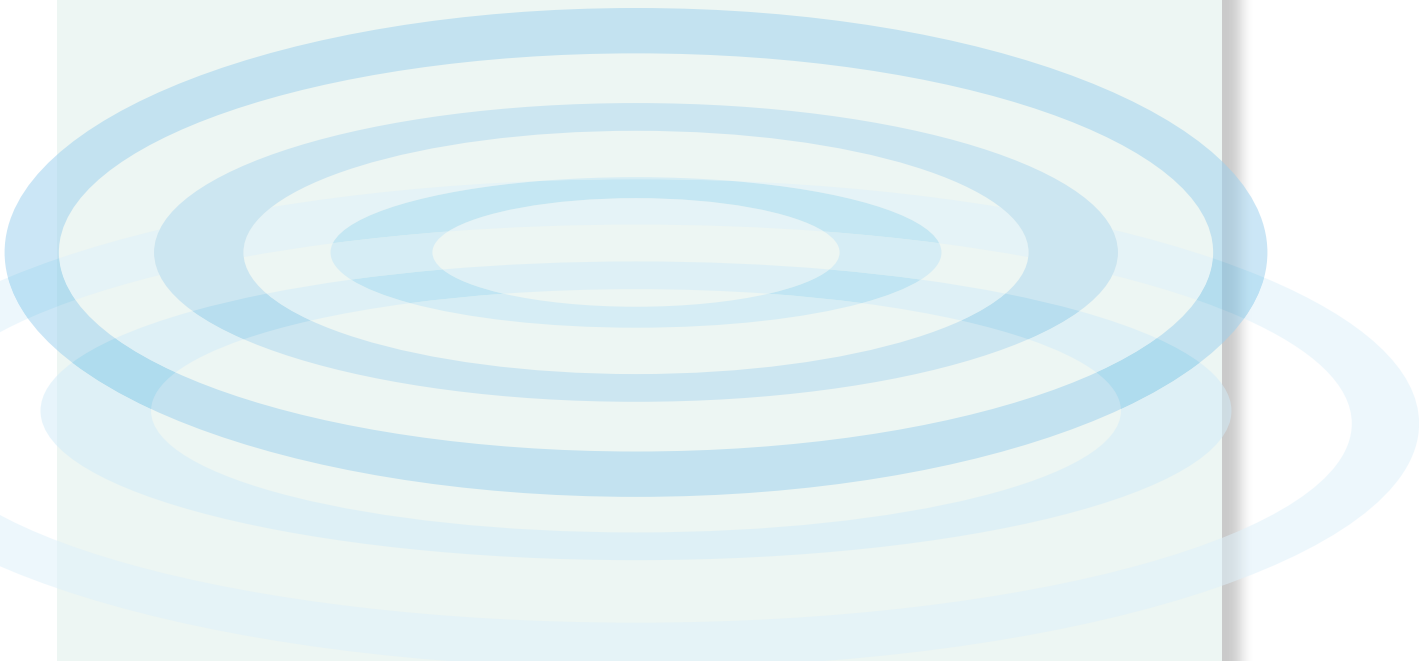
- Provide sufficient numbers of containers, safety boxes and waste bags for collection and storage of waste generated in the health care facility. These should be properly labelled to indicate the type of waste (e.g. pathological, infectious, chemical and sharps).
- If the waste is not collected frequently, make local storage available inside or near the facility.
- Use a dedicated vehicle for off-site transportation of waste to treatment and/or disposal facilities; where this is not available use a bulk container that can be lifted onto a vehicle chassis.
- Waste containers and vehicles used for the transportation of waste should be cleaned and disinfected regularly after use.
- Disinfectant solution is recommended to disinfect sharps and other health care waste products prior to disposal. This type of disinfection is not at all suitable for making medical devices reusable – it should be used solely to decrease the risk of accidental exposure to hazardous materials during transport and storage prior to treatment or final disposal.

- If routine collection and treatment services cannot be re-established before the protected waste storage area reaches its limit, on an exceptional basis the disinfected health care waste should be safely buried or disposed of on site. The site for disposal should be selected in close consultation with relevant local authorities.
- Detailed information on selecting appropriate waste treatment and disposal technologies can be found in *Safe management of wastes from health-care activities* (Chartier et al., 2014:pp105–38).

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26. Generic post-flood recovery

The health sector has a role in the provision of health advice on the clean-up process and any short- and longer-term risks to health from flood contaminants. Specifically, immediately after the flood, health professionals need to provide practical advice to people re-entering their homes; clean-up workers; and deployed personnel. Thereafter, they can help to track and minimize delayed long-term health outcomes such as mental health issues.

As floodwater recedes, health professionals should undertake the following tasks.

- Communicate with emergency services to ensure that people do not return home before it is safe.
- Highlight and raise awareness of likely carbon monoxide poisoning cases to all health services.
- Release warnings and information to the general public about risks and the need for proper ventilation when using generators and dryers.
- Raise awareness of remaining threats to food and water safety from contamination of supplies and surfaces by floodwaters – encourage people to maintain hygienic and sanitary precautions until the clean-up is complete.
- Re-emphasize health messages after a flood event, especially:
 - good hand-hygiene practices
 - boiling or chlorination of drinking-water
 - safe food-preparation techniques
 - seeking treatment early in case of fever
 - personal protection against vectors and zoonoses
 - vector control interventions, adapted to the local context and disease epidemiology.

The safety requirements for clean-up personnel should also be reiterated.

- Clean-up crews should in general wear full personal protective equipment, including waterproof safety boots, hard hats, goggles and work gloves. This is particularly essential when dealing with chemical spills or sewage contamination. Earplugs should be worn if necessary.
- Every worker should receive at least basic training on likely hazards in post-flood clean-up work.
- Clean-up workers should be vaccinated against tetanus if their vaccination status is not up to date.
- Even minor wounds, burns, cuts and injuries should be treated immediately.

Floods can have a strong effect on mental health. Mental distress is most common but is usually temporary and most people overcome it by themselves in a reasonable time.

Post-flood psychological assistance should in general be provided by psychologists and/or trained personnel. Several specific issues should be kept in mind.

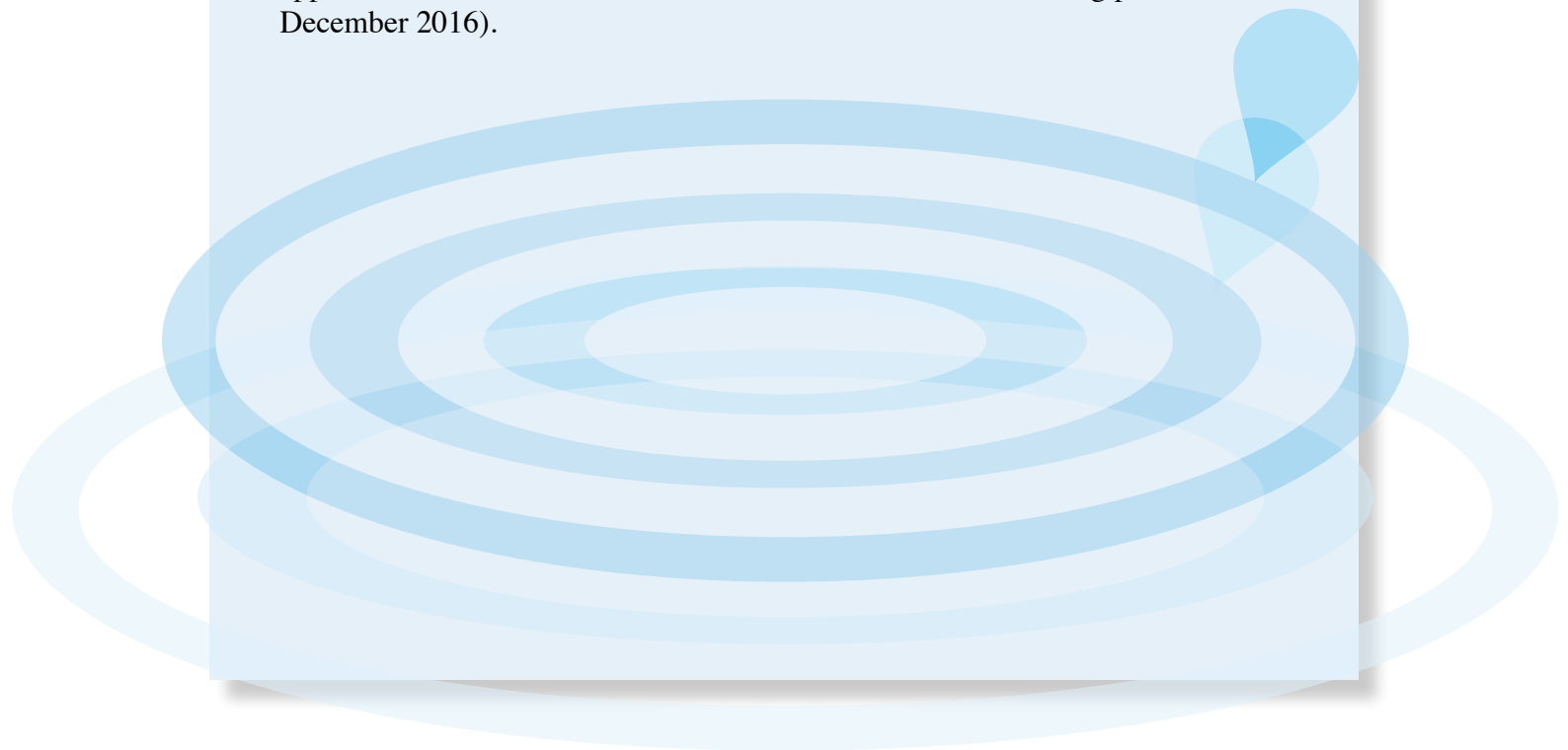
- People should be encouraged to seek assistance if psychological symptoms aggravate or persist.
- The mental health of responders and health care personnel should be considered, and may be addressed through the appropriate course determined by field psychologists.
- If considered necessary, field workers could receive training in psychological first aid (not administered by professionals).
- Long-term mental health issues (e.g. depression, post-traumatic stress disorder) should be monitored in affected communities.
- Prompt restoration of communities and social cohesion is important in the context of prevention of long-term mental health outcomes of disasters.

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27. Mould clean-up and removal after flooding

Advice to local public health authorities

- Identify mould remediation service providers and provide information to the public on available service providers in the area.
- Inform the public that large-scale mould remediation should be conducted by professional service providers.
- Inform the public that remedial work should be conducted in well ventilated rooms. Access to uncontaminated areas should be blocked to avoid the spreading of spores.
- Advise the public on careful use of detergents and cleaning products when cleaning and removing mould, ensuring that protective gear is worn (see below for details on protection).
- Advise the public to consult their doctor/GP if they suspect their health is affected by mould in the home.
- Implement inspections and train inspectors to advise private households on specific needs in their home.
- Establish a special government fund to support the costs of such services.

Remedial work is a necessary measure when flooding has triggered mould damage. The government can help to assure that remediation of mould is adequately undertaken. If existing environmental or sanitary inspectors are available, they should be called upon to support this effort.

Advice to the general public

Mould and fungal spores are common, and people are constantly exposed to spores within normal everyday life. After floods, excess moisture and standing water contribute to the growth of mould in homes and other buildings.

When re-entering your flooded home, be aware that mould may be present and could pose a health risk to your family. If you find mould growing in your home, affected areas or items should be treated to remove mould spores as soon as possible.

Home cleaning and removal of moulds is achieved by three steps: clean, dry and disinfect.

- Small areas of mould can be easily removed by using detergent/warm water or 70% alcohol to rinse and clean off walls and hard surfaces.
- The most important measure in controlling mould is to control moisture levels in the environment. Heating, dehumidifiers and good ventilation can help to dry out your home.
- Mould on damp walls will stop growing as your home dries out.

To start – protect yourself

- Take care with electricity and gas. Gas or electric appliances that may have been wet should be turned on only when they have been checked, if possible by a qualified technician.
- Wear rubber boots, waterproof gloves and an apron while cleaning. Wear a standard face mask (such as those available from hardware stores) if scrubbing, hosing or pressure washing causes water to splash, or the release of dust particles. Goggles offer added protection and can be reused after thorough washing, if necessary.
- Ventilate the work area before and during cleaning but close doors to uncontaminated rooms to avoid spread of mould spores.

How and what to clean and disinfect

- If belongings were wet for two or more days, take them outside. Cloth items can be washed in hot water.
- Remove contaminated or mouldy materials and debris that have been contaminated with sewage, floodwater sludge or mud.
- Remove building material containing cellulose or processed wooden fibres (gypsum board coated with cellulose, cardboard, wood fibreboard, oriented strand board, medium-density fibreboard) unless it is naturally grown solid wood. Material containing cellulose has a high risk for growth of *Stachybotrys* (toxic mould) so cellulose and wood fibre materials used in hidden spaces, where mould growth is not visible, should be removed first.
- Place waste in hard bins or rubbish bags.
- Clean all hard surfaces (such as walls and floors) with hot water and detergent. If the surface is rough, scrub with a stiff brush.
- Remember to wash hands thoroughly after each clean-up. Keep open cuts or sores clean and use waterproof plasters to prevent exposure to floodwater.

Drying out

- Heating, dehumidifiers and good ventilation can help to dry out your home.
- When using indoor heating appliances to dry out an indoor space, ensure that there is adequate ventilation. Do not use petrol or diesel generators or other fuel-driven equipment indoors as exhaust gases contain carbon monoxide, which can be harmful.
- Gas or oil central heating can be turned on when it has been checked by an engineer. Keep the thermostat between 20 °C and 22 °C for steady drying.
- Ensure that any air vents under floor spaces are unblocked to provide cross-ventilation in these areas. As floorboards and walls dry out, loose material and the resulting dust should be vacuumed regularly.

- When possible, remove dirty water and silt from the property. Rooms below ground level may need pumping out, especially if you have wooden flooring. Mould should disappear as your home dries out. If it persists, contact a specialist cleaner and local public health authority for help.

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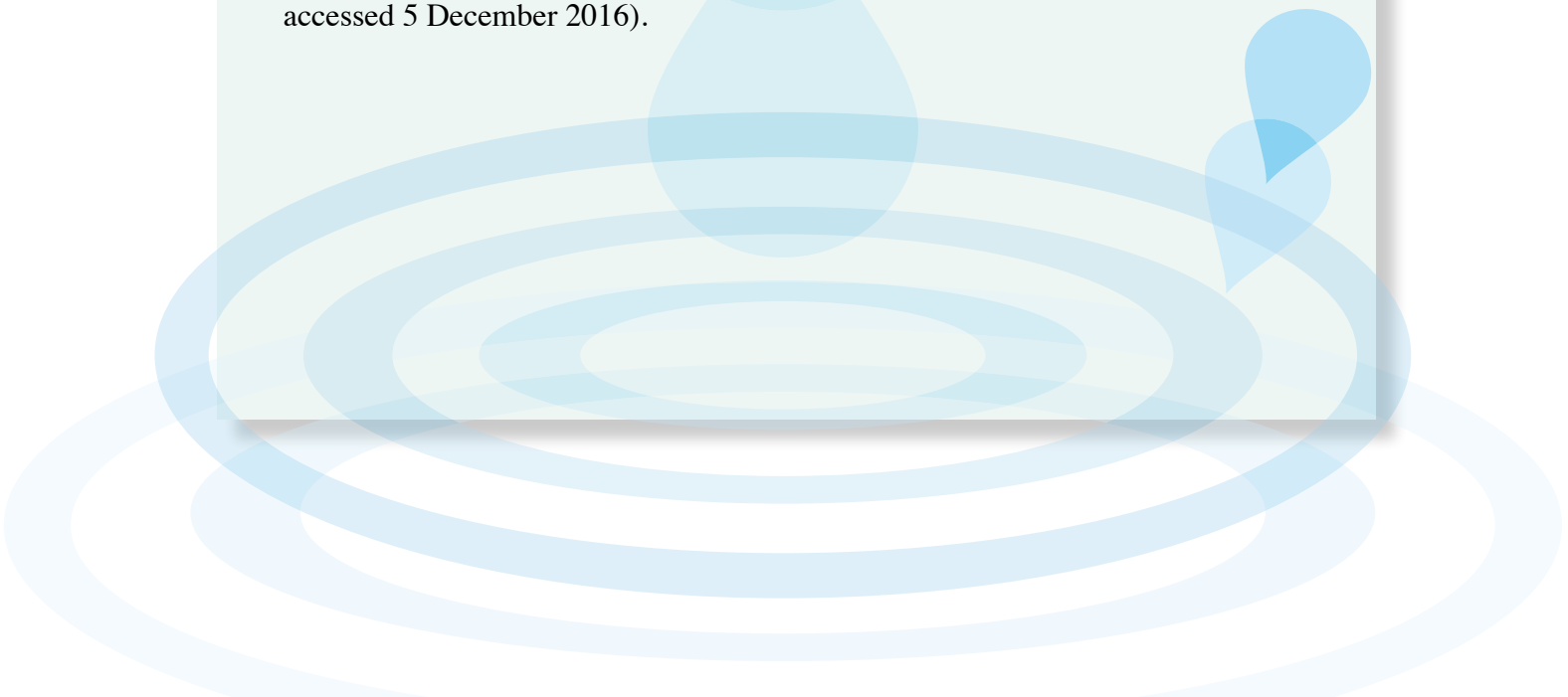
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